APPENDIX B

Calculations of Site-Specific Background Concentrations of Metals in Soil

APPENDIX B

SITE-SPECIFIC BACKGROUND CONCENTRATIONS OF METALS IN SOIL

Former Pechiney Cast Plate, Inc. Facility
3200 Fruitland Avenue
Vernon, California

1.0 INTRODUCTION

Naturally-occurring inorganic constituents (i.e., metals) detected in soil at a site may be eliminated as chemicals of potential concern (COPCs) if detected concentrations are consistent with local or site-specific background conditions (also referred to as "ambient conditions," or conditions unaffected by past site-related activities). The derivation of local or site-specific background concentrations may also be used to evaluate if remedial action or risk management measures specific to metals in soil is warranted. Because of the high density of industrial land use surrounding the former Pechiney Cast Plate, Inc. Facility (the Site), collecting soil samples to establish local background concentrations would not be appropriate or applicable to the Site. Instead, site-specific background concentrations of metals in soil were derived for the Site from on-site data as described herein. The analysis presented has been prepared in accordance with several California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) guidance documents including:

- Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities, February 1997 (DTSC, 1997);[1] and

- Arsenic Strategies, Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals, January 16, 2009 (DTSC, 2009).[2]

Information regarding the lithology of the Site, along with a description of the previous on-site investigations for metals in soil, is presented in Sections 2.0 through 3.0 of the Feasibility Study (FS). The metals data collected from these previous investigations and evaluated for use in the derivation of site-specific background concentrations are presented in Appendix A

[1] Department of Toxic Substances Control (DTSC), 1997, Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessment at Hazardous Waste Sites and Permitted Facilities, February.

[2] Department of Toxic Substances Control (DTSC), 2009, Arsenic Strategies, Determination of Arsenic Remediation, Development Arsenic Cleanup Goals, January 16.

of the FS. A description of the approach and methods used to derive the site-specific background concentrations is presented in the following sections.

2.0 DATA EVALUATION

As presented in Appendix A of the FS, 486 soil samples were collected from the ground surface to a depth of 50 feet below ground surface (bgs) at the Site between 1991 and 2007 and analyzed for metals using U.S. EPA Method 6010B or U.S. EPA Method 7471A (for mercury). Of these 486 soil samples, 249 soil samples are no longer in place following excavations (marked as "Excavated" in Appendix A). Only the analytical results from the 237 "left-in-place" soil samples were considered for the evaluation of background conditions. Summary statistics for the analytical results of these samples are presented in Table B-1.

Metals with low frequency of detection were excluded from the evaluation of site-specific background. Specifically, antimony, beryllium, cadmium, hexavalent chromium, molybdenum, selenium, silver, and thallium were excluded, with detection frequencies between 0 and 6 percent. The detection frequencies for the remaining 10 metals detected at the Site (arsenic, barium, total chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc) were considered sufficient to warrant statistical and graphical evaluation.

Detection limits were not available for two non-detect results of lead for samples UST-2B-1 and UST-2B-2 collected in 1995. The non-detect results were simply listed as ND in the provided data tables associated with the removal of the underground storage tanks (laboratory reports for these samples were not available). These non-detect results were therefore excluded from the subsequent statistical evaluations.

3.0 SITE-SPECIFIC BACKGROUND CONCENTRATIONS

The statistical and graphical methods applied to evaluate and identify site-specific background concentrations for metals in soil included a goodness-of-fit and probability plots. First, each metal was evaluated using goodness-of-fit tests and probability plots to determine if single or multiple data populations exist within each dataset. Gaps or inflection points identified from the probability plots, for example, would be indicative of a shift from background concentrations to site-related concentrations (DTSC, 1997). For those metals for which inflection points could not be identified but for which the goodness-of-fit tests suggested multiple data populations were present, additional statistical evaluations were performed to identify outliers (impacted soil samples) and estimate site-specific background concentrations.

3.1 DISTRIBUTION EVALUATION AND IDENTIFICATION OF INFLECTION POINTS

Consistent with DTSC guidance (DTSC, 1997), the distribution of each dataset was evaluated to determine if multiple distributions were present. Distributions were tested using the Lilliefor's goodness-of-fit test function in U.S. EPA's ProUCL product, Version 4.00.04 (ProUCL) (U.S. EPA, 2009)[3] and were also evaluated graphically with normal and lognormal probability plots generated using ProUCL. Dataset distributions that fail goodness-of-fit tests for normality and lognormality and/or the presence of inflection points in a probability plot generally indicate that a dataset is comprised of multiple populations (DTSC, 1997). In these cases, background conditions are defined as the range of concentrations associated with the population nearest the origin (i.e., the first population) (DTSC, 1997; 2009).

The results of the goodness-of-fit testing for each metal are presented in Attachment B-1. As shown, only one dataset was considered to fit a normal, lognormal, or gamma theoretical distribution; the distribution of the mercury data set was determined to fit a lognormal distribution, but only when excluding the non-detect results. Therefore, it is likely that the datasets of all 10 metals evaluated are comprised of both background and site-related data populations.

Normal and lognormal probability plots are presented for each metal in Attachment B-2. Detection limits ranged widely from samples collected and analyzed during the 1990s to more recent analytical results. For example, the detection limits for non-detect results of arsenic ranged from 0.05 milligrams per kilogram (mg/kg) to 60 mg/kg (for two samples, H-1 and H-2; Appendix A). The presence of multiple non-detect results within the range of detected concentrations created "noise" within some of the probability plots. To aid in the identification of distribution types and possible gaps or inflection points, normal and lognormal probability plots were also prepared by excluding these non-detect results.

Inflection points were identified for the following metals from the various probability plots (Attachment B-2):

- Arsenic – Inflection point at 9.9 mg/kg, based on the normal probability plot with non-detect results removed;
- Copper – Inflection point at 35 mg/kg, based on the normal probability plot of the complete data set;
- Mercury – Inflection point at 0.18 mg/kg, based on the normal or lognormal probability plots with non-detect results removed;

- Nickel – Inflection point at 17 mg/kg, based on the normal probability plots for the complete data set or with the non-detect results removed; and

- Zinc – Inflection point at 92 mg/kg, based on the normal probability plot of the complete data set.

These inflection points were identified as the site-specific background concentrations for these metals, with one exception. As the inflection point for arsenic, 9.9 mg/kg, was in agreement with a 10 mg/kg background concentration previously established by the City of Vernon using comparable graphical methods (City of Vernon H&EC, letter dated April 28, 2008),[4] 10 mg/kg was used as the site-specific background concentration for arsenic at the Site.

Inflection points were not identified from the probability plots for barium, total chromium, cobalt, lead, or vanadium that would potentially distinguish background from site-related data populations. As a result, the datasets for these metals were subjected to further statistical evaluations to estimate site-specific background concentrations as described in Section 3.2.

3.2 OUTLIER EVALUATION AND ESTIMATION OF UPPER LIMITS

Because inflection points could not be identified from the probability plots for barium, total chromium, cobalt, lead, and vanadium, upper limit concentrations were quantitatively estimated as representative of site-specific background concentrations. Each dataset was first evaluated for potential outliers. Outliers should be removed prior to estimating an upper limit concentration to ensure the upper limit estimate is not overly influenced by one or two observations, but "conforms to the pattern established by the majority of values in the dataset" (DTSC, 2009). Rosner's test was applied with ProUCL to qualitatively test for the presence of outliers (see Attachment B-3). Outliers were identified in the total chromium, lead, and vanadium background datasets and were excluded from their respective datasets prior to estimating the upper limit concentrations. The outliers identified by Rosner's test are depicted in the probability plots in Attachment B-2.

[3] U.S. EPA, 2009, ProUCL Version 4.00.04, Technical Guide, Office of Research and Development, Washington DC, April.

[4] City of Vernon Health & Environmental Control, 2008, letter to Ms. Linda Conlan re: Comments on Revised Geomatrix Feasibility Study/Remedial Action Plan (FS/RAP), Former Pechiney Cast Plate, Inc. Facility, 3200 Fruitland Avenue, Vernon, California, April 28.

With the suspected outliers removed, the upper limit concentrations for barium, total chromium, cobalt, lead, and vanadium were estimated using the following equation (DTSC, 2009):

$$UL = x_bar + K * sd \quad (1)$$

Where:	UL	=	the upper limit of the dataset
	x_bar	=	the mean of detected concentrations in the dataset
	K	=	statistical tolerance factor for estimating an upper confidence limit on a given percentile of the population
	*	=	multiply
	sd	=	the standard deviation of the mean

The value of the statistical tolerance factor was determined from a table in Gilbert (1987)[5] based on sample size, upper confidence limit, and quantile of the data population. As defined by DTSC (DTSC, 2009), the 95 percent upper confidence limit on the 99th quantile of each dataset was estimated for each metal, using a statistical tolerance factor based on data population parameters. The calculation of the upper limit concentrations of background is presented in Table B-2 for barium, total chromium, cobalt, lead, and vanadium.

3.3 SUMMARY OF SITE-SPECIFIC BACKGROUND CONCENTRATIONS

A summary of the site-specific background concentrations for metals at the Site, identified as inflection points from normality plots or quantified as upper limit concentrations from background populations, is presented in Table B-3.

[5] Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold Co., New York.

TABLE B-1

SUMMARY STATISTICS OF ANALYTICAL RESULTS FOR METALS

Former Pechiney Cast Plate, Inc. Facility

Vernon, California

Results are shown in milligrams per kilogram (mg/kg)

Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium, Hexavalent	Chromium, Total	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Count	217	216	217	217	217	23	219	217	219	221	217	217	217	217	217	217	217	217
Number of Detects	0	147	217	0	13	1	219	203	219	186	61	2	208	2	1	4	217	217
Number of Non-Detects	217	69	0	217	204	22	0	14	0	35	156	215	9	215	216	213	0	0
Mean Detected Concentration	NA	5.0	92.3	NA	1.25	0.35	12.9	8.0	20.3	9.4	0.12	6	9.6	1.41	5	1.24	32.5	58.0
Median Concentration	NA	1.9	93.9	NA	NA	NA	13	8	17	2.8	NA	NA	9.3	NA	NA	NA	34.0	51.0
Standard Deviation of Detections	NA	13.0	33.1	NA	0.66	NA	4.8	2.4	23.6	18.7	0.14	1.41	3.5	1.12	NA	0.61	9.6	52.1
Coefficient of Variation of Detections	NA	2.6	0.4	NA	0.53	NA	0.37	0.30	1.2	2.0	1.21	0.24	0.36	0.79	NA	0.49	0.30	0.9
Minimum Detection	0	0.63	23	0	0.54	0.35	2.7	2.2	3.3	0.62	0.023	5	2.4	0.62	5	0.74	7.6	13.3
Maximum Detection	0	120	190	0	2.8	0.35	32.1	16	257	157	0.98	7	27	2.2	5	2.1	70	607
Minimum Reporting Limit	5	0.05	0	0.5	0.5	0.04	0	3	0	3	0.02	4	3	0.5	1	0.5	0	0
Maximum Reporting Limit	12	60	0	1	1	0.04	0	10	0	20	0.1	8	4	1	2	100	0	0
Detection Frequency	0%	68%	100%	0%	6%	4%	100%	94%	100%	84%	28%	1%	96%	1%	0.5%	2%	100%	100%

Abbreviations:
NA = not applicable

TABLE B-2

CALCULATION OF UPPER LIMIT CONCENTRATIONS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Results are shown in milligrams per kilogram (mg/kg)

	Barium	Chromium, Total	Cobalt	Lead	Vanadium
First Population					
Number of Detections	217	218	203	185	216
Number of Outliers	0	1 (32.1)	0	1 (157)	1 (70)
Mean Detection	92.3	12.9	7.95	8.59	32.3
Standard Deviation of Detections	33.1	4.63	2.35	15.3	9.25
K	2.62	2.62	2.62	2.62	2.62
$UL_{95}(X_{99})$	**179**	**25**	**14.1**	**48.5**	**56.5**

Abbreviations:

K = statistical tolerance factor (from Gilbert, 1987).
$UL_{95}(X_{99})$ = 95 percent upper limit for the 99th quantile.

Equations:

$$UL_{95}(X_{99}) = x_bar + K * sd$$

TABLE B-3

SUMMARY OF SITE-SPECIFIC BACKGROUND CONCENTRATIONS FOR METALS

Former Pechiney Cast Plate, Inc. Facility

Vernon, California

Results are shown in milligrams per kilogram (mg/kg)

Metal	Site-Specific Background Concentration	Basis
Arsenic	10	Inflection Point[1]
Barium	179	Upper Limit Concentration
Chromium, Total	25	Upper Limit Concentration
Cobalt	14.1	Upper Limit Concentration
Copper	35	Inflection Point
Lead	48.5	Upper Limit Concentration
Mercury	0.18	Inflection Point
Nickel	17	Inflection Point
Vanadium	56.5	Upper Limit Concentration
Zinc	92	Inflection Point

Notes:

1. As the inflection point for arsenic, 9.9 mg/kg, was in agreement with a 10 mg/kg background concentration previously established by the City of Vernon using comparable graphical methods (City of Vernon H&EC, letter dated April 28, 2008); 10 mg/kg was used as the site-specific background concentration for arsenic at the Site.

ATTACHMENT B-1

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Arsenic

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	216	0	216	147	69	0.3194

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	69	0.05	60	15.92	1	16.5
Statistics (Detects Only)	147	0.63	120	4.982	2.5	13.01
Statistics (All: NDs treated as DL value)	216	0.05	120	8.477	2.5	15.08
Statistics (All: NDs treated as DL/2 value)	216	0.025	120	5.934	2.5	11.77
Statistics (Normal ROS Estimated Data)	216	-21.89	120	1.761	2.15	12.74
Statistics (Gamma ROS Estimated Data)	216	1E-09	120	4.507	2.35	11.15
Statistics (Lognormal ROS Estimated Data)	216	0.185	120	3.878	2.103	10.89

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.947	0.937	5.263	0.992	0.789	0.795
Statistics (NDs = DL)	0.598	0.593	14.17	1.104	1.364	1.236
Statistics (NDs = DL/2)	0.676	0.67	8.777	0.882	1.364	1.546
Statistics (Gamma ROS Estimates)	0.173	0.174	26.03	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	0.671	0.944	1.407

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.491	0.728	0.646	0.728

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.414	0.0731	Data Not Normal
Lilliefors (NDs = DL)	0.378	0.0603	Data Not Normal
Lilliefors (NDs = DL/2)	0.324	0.0603	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.287	0.0603	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.729	0.938	0.879	0.925

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	20.47	0.786	
Kolmogorov-Smirnov (Detects Only)	0.308	0.0798	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	18.73	0.811	
Kolmogorov-Smirnov (NDs = DL)	0.277	0.0649	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	9.118	0.804	
Kolmogorov-Smirnov (NDs = DL/2)	0.208	0.0646	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	40.75	0.968	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.382	0.0698	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.895	0.952	0.97	0.963

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.187	0.0731	Data Not Lognormal
Lilliefors (NDs = DL)	0.174	0.0603	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.125	0.0603	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.108	0.0603	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Barium

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	217	0	0.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Full: no NDs)	217	23	190	92.28	93.9	33.06

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Full: no NDs)	6.173	6.091	14.95	4.442	0.445	0.1

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.992	0.992	0.992	0.992

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.0772	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.968	0.968	0.968	0.968

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Full: no NDs)	4.447	0.755	
Kolmogorov-Smirnov (Full: no NDs)	0.112	0.0618	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.947	0.947	0.947	0.947

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.14	0.0601	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Chromium, Total

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	18	219	219	0	0.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Full: no NDs)	219	2.7	32.1	12.95	13	4.797

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Full: no NDs)	5.491	5.419	2.358	2.467	0.481	0.195

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.981	0.981	0.981	0.981

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.102	0.0599	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.955	0.955	0.955	0.955

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Full: no NDs)	7.381	0.756	
Kolmogorov-Smirnov (Full: no NDs)	0.167	0.0616	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.928	0.928	0.928	0.928

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.195	0.0599	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Cobalt

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	203	14	6.45%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	14	3	10	5.286	5	2.164
Statistics (Detects Only)	203	2.2	16	7.951	8.1	2.351
Statistics (All: NDs treated as DL value)	217	2.2	16	7.779	8	2.425
Statistics (All: NDs treated as DL/2 value)	217	1.5	16	7.609	8	2.636
Statistics (Normal ROS Estimated Data)	217	2.2	16	7.717	8	2.469
Statistics (Gamma ROS Estimated Data)	217	1.57	16	7.722	8	2.484
Statistics (Lognormal ROS Estimated Data)	217	2.2	16	7.727	8	2.443

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	8.802	8.684	0.903	2.015	0.373	0.185
Statistics (NDs = DL)	8.115	8.006	0.959	1.989	0.386	0.194
Statistics (NDs = DL/2)	6.014	5.934	1.265	1.944	0.462	0.238
Statistics (Gamma ROS Estimates)	7.371	7.272	1.048	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	1.981	0.388	0.196

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.981	0.985	0.976	0.984

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.1	0.0622	Data Not Normal
Lilliefors (NDs = DL)	0.0945	0.0601	Data Not Normal
Lilliefors (NDs = DL/2)	0.117	0.0601	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.101	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.956	0.961	0.94	0.955

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	6.774	0.752	
Kolmogorov-Smirnov (Detects Only)	0.155	0.0633	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	6.133	0.753	
Kolmogorov-Smirnov (NDs = DL)	0.148	0.0617	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	9.8	0.755	
Kolmogorov-Smirnov (NDs = DL/2)	0.178	0.0618	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	7.216	0.754	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.157	0.0617	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.92	0.935	0.912	0.939

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.18	0.0622	Data Not Lognormal
Lilliefors (NDs = DL)	0.172	0.0601	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.202	0.0601	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.176	0.0601	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Copper

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	18	219	219	0	0.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Full: no NDs)	219	3.3	257	20.31	17	23.63

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Full: no NDs)	2.41	2.38	8.427	2.789	0.591	0.212

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.608	0.608	0.608	0.608

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.29	0.0599	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.736	0.736	0.736	0.736

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Full: no NDs)	8.2	0.764	
Kolmogorov-Smirnov (Full: no NDs)	0.156	0.0621	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.96	0.96	0.96	0.96

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.103	0.0599	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Lead

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	18	219	186	33	15.07%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	33	3	20	10.18	10	3.046
Statistics (Detects Only)	186	0.62	157	9.385	3.3	18.7
Statistics (All: NDs treated as DL value)	219	0.62	157	9.505	4.2	17.27
Statistics (All: NDs treated as DL/2 value)	219	0.62	157	8.738	4.2	17.31
Statistics (Normal ROS Estimated Data)	219	-14.19	157	8.647	3.3	17.59
Statistics (Gamma ROS Estimated Data)	219	1E-09	157	9.218	3.5	17.48
Statistics (Lognormal ROS Estimated Data)	219	0.51	157	8.505	3.2	17.38

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.782	0.774	12	1.478	1.107	0.749
Statistics (NDs = DL)	0.894	0.885	10.63	1.597	1.067	0.668
Statistics (NDs = DL/2)	0.87	0.861	10.04	1.493	1.029	0.689
Statistics (Gamma ROS Estimates)	0.46	0.457	20.02	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	1.41	1.07	0.759

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.647	0.652	0.629	0.676

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.32	0.065	Data Not Normal
Lilliefors (NDs = DL)	0.303	0.0599	Data Not Normal
Lilliefors (NDs = DL/2)	0.319	0.0599	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.278	0.0599	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.884	0.867	0.859	0.923

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	9.753	0.794	
Kolmogorov-Smirnov (Detects Only)	0.187	0.0699	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	7.432	0.789	
Kolmogorov-Smirnov (NDs = DL)	0.142	0.0635	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	10.94	0.79	
Kolmogorov-Smirnov (NDs = DL/2)	0.221	0.0636	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	11.6	0.831	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.2	0.0653	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.978	0.985	0.982	0.98

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.119	0.065	Data Not Lognormal
Lilliefors (NDs = DL)	0.0924	0.0599	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.135	0.0599	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.105	0.0599	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Mercury

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	61	156	71.89%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	156	0.02	0.1	0.0964	0.1	0.0166
Statistics (Detects Only)	61	0.023	0.98	0.119	0.084	0.143
Statistics (All: NDs treated as DL value)	217	0.02	0.98	0.103	0.1	0.0776
Statistics (All: NDs treated as DL/2 value)	217	0.01	0.98	0.068	0.05	0.0823
Statistics (Normal ROS Estimated Data)	217	-0.228	0.98	0.0402	0.0436	0.117
Statistics (Gamma ROS Estimated Data)	217	0.023	0.98	0.109	0.0995	0.0802
Statistics (Lognormal ROS Estimated Data)	217	0.0059	0.98	0.0651	0.0456	0.0858

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	1.529	1.511	0.0777	-2.492	0.783	-0.314
Statistics (NDs = DL)	3.954	3.903	0.026	-2.408	0.503	-0.209
Statistics (NDs = DL/2)	2.443	2.413	0.0278	-2.906	0.564	-0.194
Statistics (Gamma ROS Estimates)	3.871	3.821	0.0281	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-3.09	0.798	-0.258

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.739	0.59	0.556	0.904

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.256	0.113	Data Not Normal
Lilliefors (NDs = DL)	0.403	0.0601	Data Not Normal
Lilliefors (NDs = DL/2)	0.398	0.0601	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.108	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.895	0.67	0.706	0.798

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	2.031	0.769	
Kolmogorov-Smirnov (Detects Only)	0.137	0.116	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	33.32	0.757	
Kolmogorov-Smirnov (NDs = DL)	0.357	0.062	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	37.93	0.764	
Kolmogorov-Smirnov (NDs = DL/2)	0.401	0.0623	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	3.24	0.757	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.103	0.062	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.976	0.82	0.811	0.994

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.0929	0.113	Data Appear Lognormal
Lilliefors (NDs = DL)	0.394	0.0601	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.37	0.0601	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.0413	0.0601	Data Appear Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Nickel

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	208	9	4.15%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	9	3	4	3.444	3	0.527
Statistics (Detects Only)	208	2.4	27	9.619	9.4	3.486
Statistics (All: NDs treated as DL value)	217	2.4	27	9.363	9.3	3.63
Statistics (All: NDs treated as DL/2 value)	217	1.5	27	9.291	9.3	3.76
Statistics (Normal ROS Estimated Data)	217	0.503	27	9.32	9.3	3.71
Statistics (Gamma ROS Estimated Data)	217	1E-09	27	9.318	9.3	3.719
Statistics (Lognormal ROS Estimated Data)	217	2.4	27	9.389	9.3	3.59

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	7.416	7.316	1.297	2.195	0.389	0.177
Statistics (NDs = DL)	6.251	6.168	1.498	2.155	0.428	0.199
Statistics (NDs = DL/2)	5.006	4.939	1.856	2.126	0.506	0.238
Statistics (Gamma ROS Estimates)	2.767	2.732	3.367	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	2.162	0.413	0.191

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.972	0.975	0.978	0.979

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.0863	0.0614	Data Not Normal
Lilliefors (NDs = DL)	0.0755	0.0601	Data Not Normal
Lilliefors (NDs = DL/2)	0.0704	0.0601	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.0724	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.985	0.985	0.978	0.971

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	1.324	0.754	
Kolmogorov-Smirnov (Detects Only)	0.0651	0.0628	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	2.044	0.755	
Kolmogorov-Smirnov (NDs = DL)	0.079	0.0618	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	4.226	0.756	
Kolmogorov-Smirnov (NDs = DL/2)	0.103	0.0618	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	11.78	0.762	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.183	0.0622	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.975	0.972	0.936	0.978

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Detects Only)	0.0907	0.0614	Data Not Lognormal
Lilliefors (NDs = DL)	0.107	0.0601	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.136	0.0601	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.0991	0.0601	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Vanadium

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	217	0	0.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Full: no NDs)	217	7.6	70	32.46	34	9.579

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Full: no NDs)	8.983	8.862	3.613	3.423	0.368	0.107

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.976	0.976	0.976	0.976

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.115	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.952	0.952	0.952	0.952

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Full: no NDs)	7.894	0.753	
Kolmogorov-Smirnov (Full: no NDs)	0.169	0.0617	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.924	0.924	0.924	0.924

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.195	0.0601	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

ProUCL 4.00.04 OUTPUT -- GOODNESS-OF-FIT TESTS

Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Zinc

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	237	20	217	217	0	0.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Full: no NDs)	217	13.3	607	58.04	51	52.09

	K Hat	K Star	Theta Hat	Log Mean	Log Stdv	Log CV
Statistics (Full: no NDs)	3.501	3.455	16.58	3.912	0.488	0.125

Normal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.638	0.638	0.638	0.638

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.28	0.0601	Data Not Normal

Gamma Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.742	0.742	0.742	0.742

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Full: no NDs)	8.271	0.759	
Kolmogorov-Smirnov (Full: no NDs)	0.166	0.062	Data Not Gamma Distributed

Lognormal Distribution Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.955	0.955	0.955	0.955

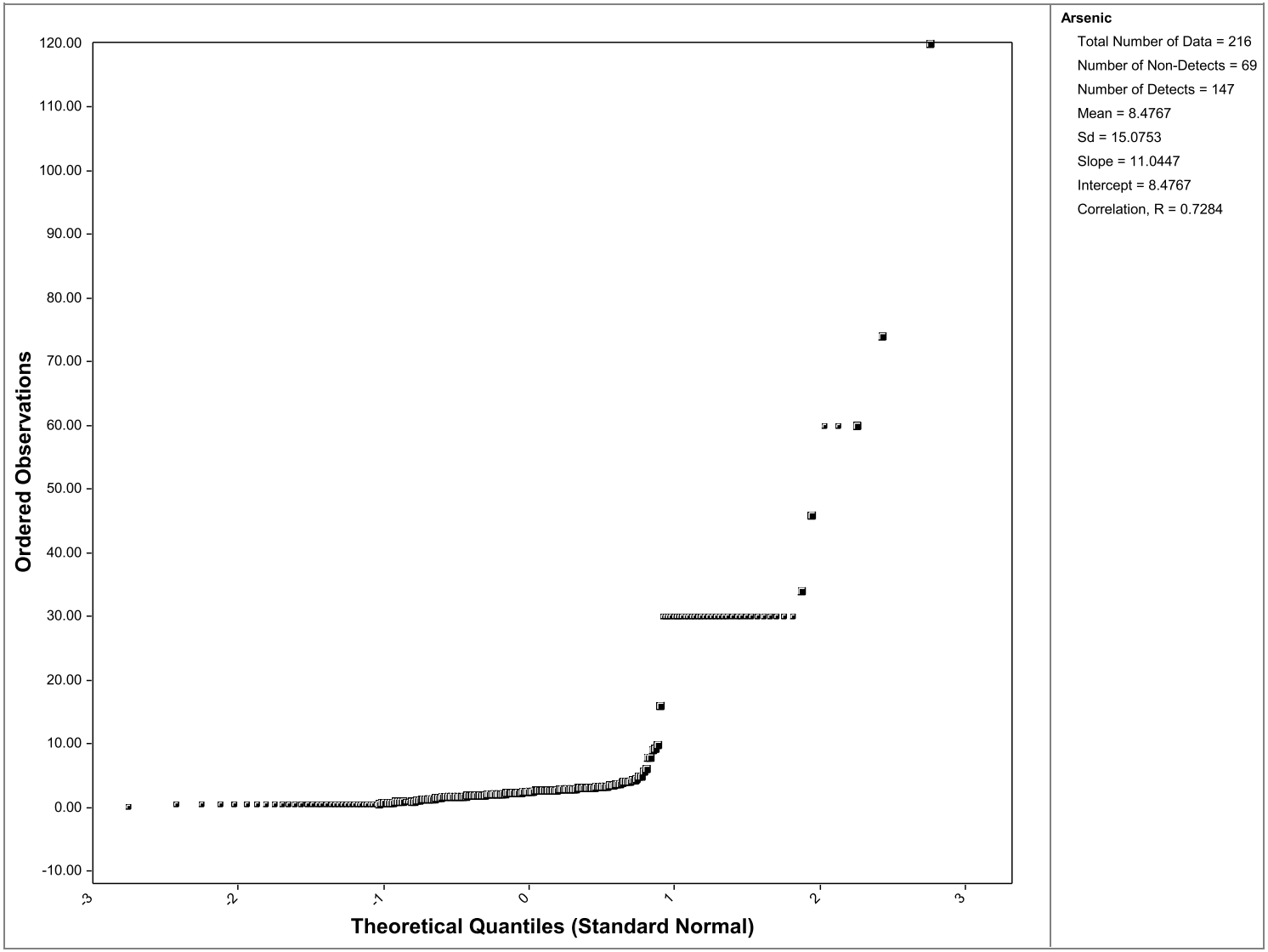
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Lilliefors (Full: no NDs)	0.116	0.0601	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

S:\10600\10627\10627.003\task-8_fig_arsenic_1-4.ai

Attachment B-2

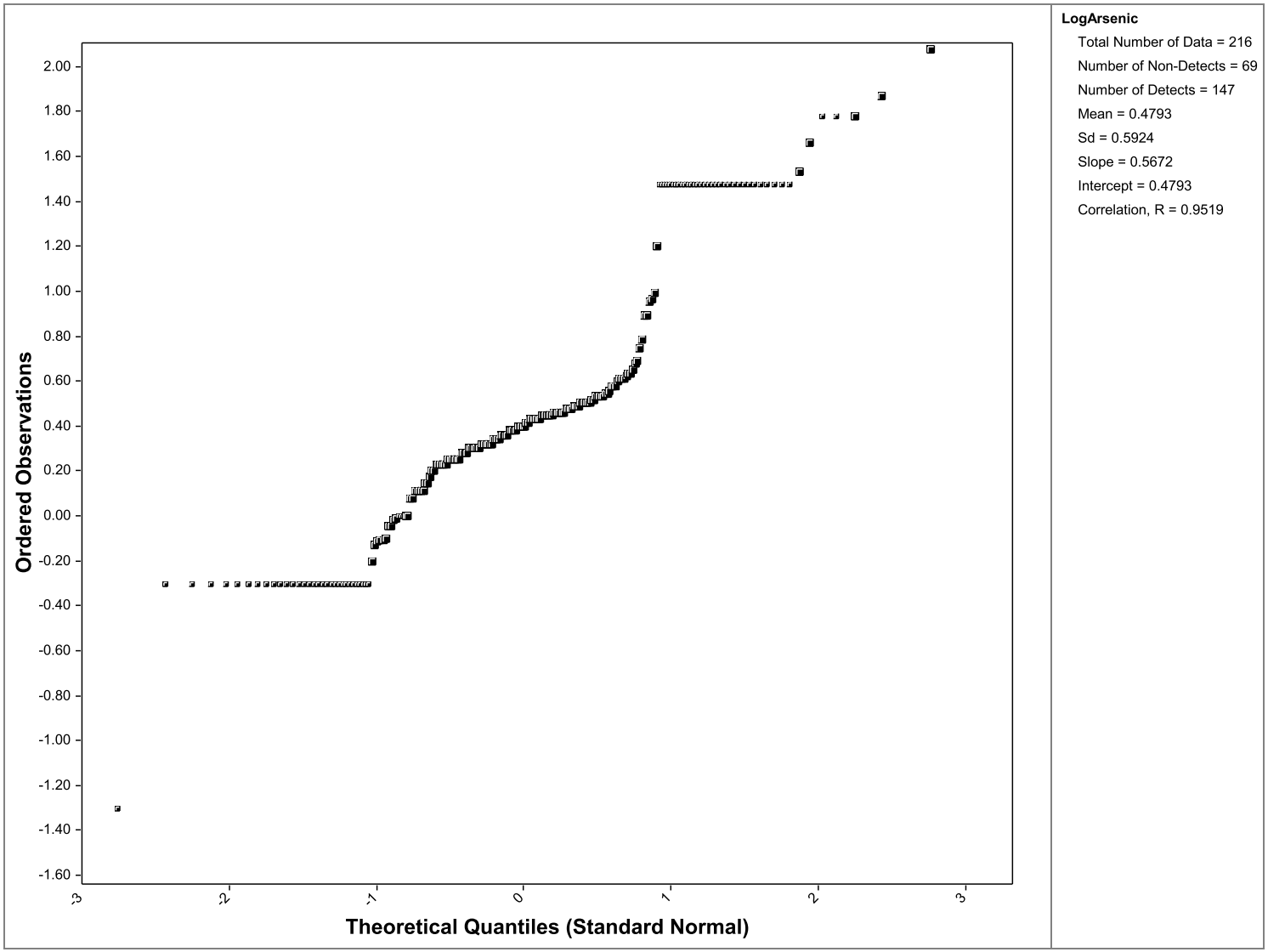
Normal Probability Plot for Arsenic



S:\10600\10627\10627.003\task-8_fig_arsenic_1-4.ai

Attachment B-2

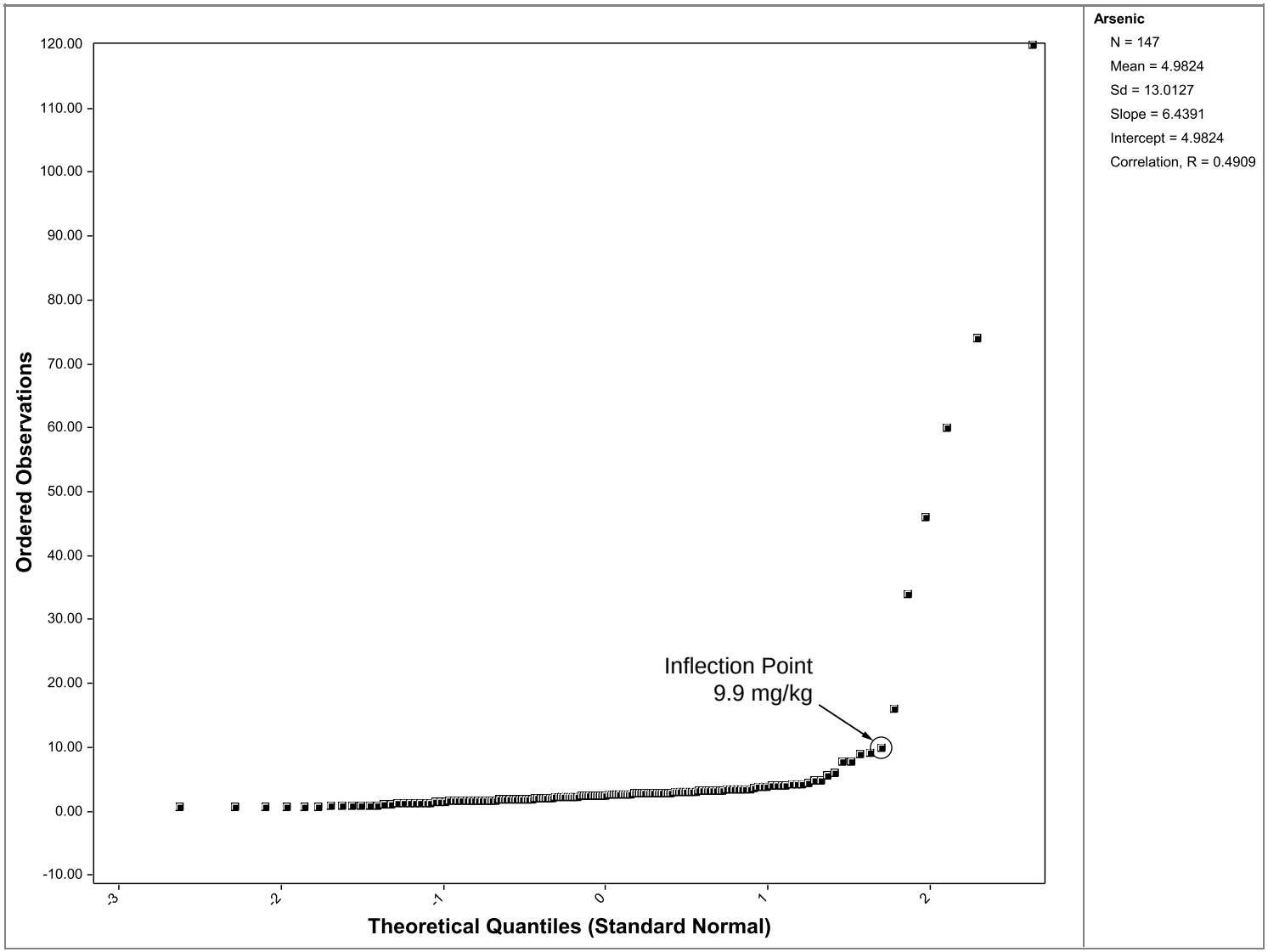
Lognormal Probability Plot for Arsenic



S:\10600\10627\10627.003\task-8_fig_arsenic_1-4.ai

Attachment B-2

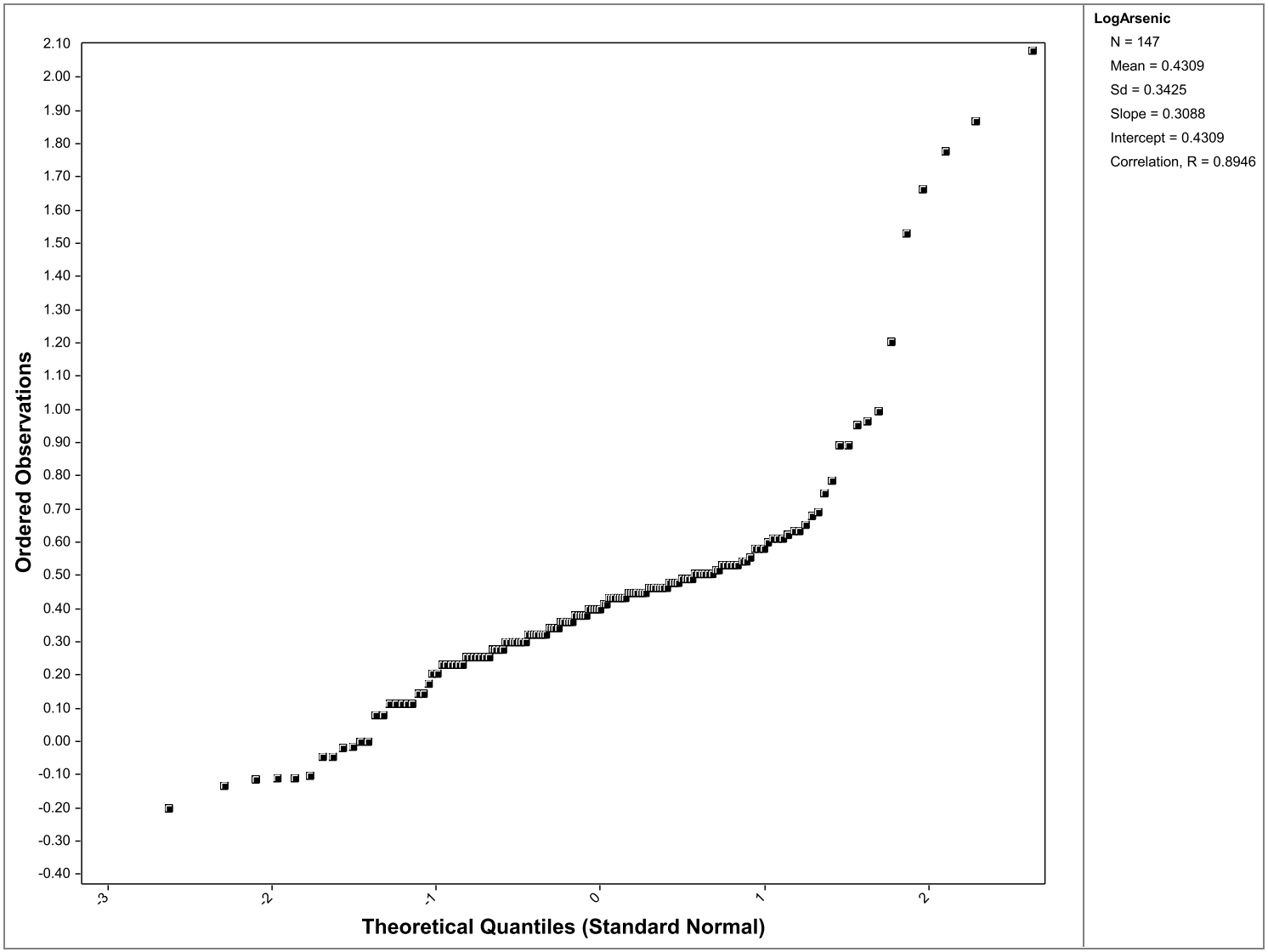
Normal Probability Plot for Arsenic, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_arsenic_1-4.ai

Attachment B-2

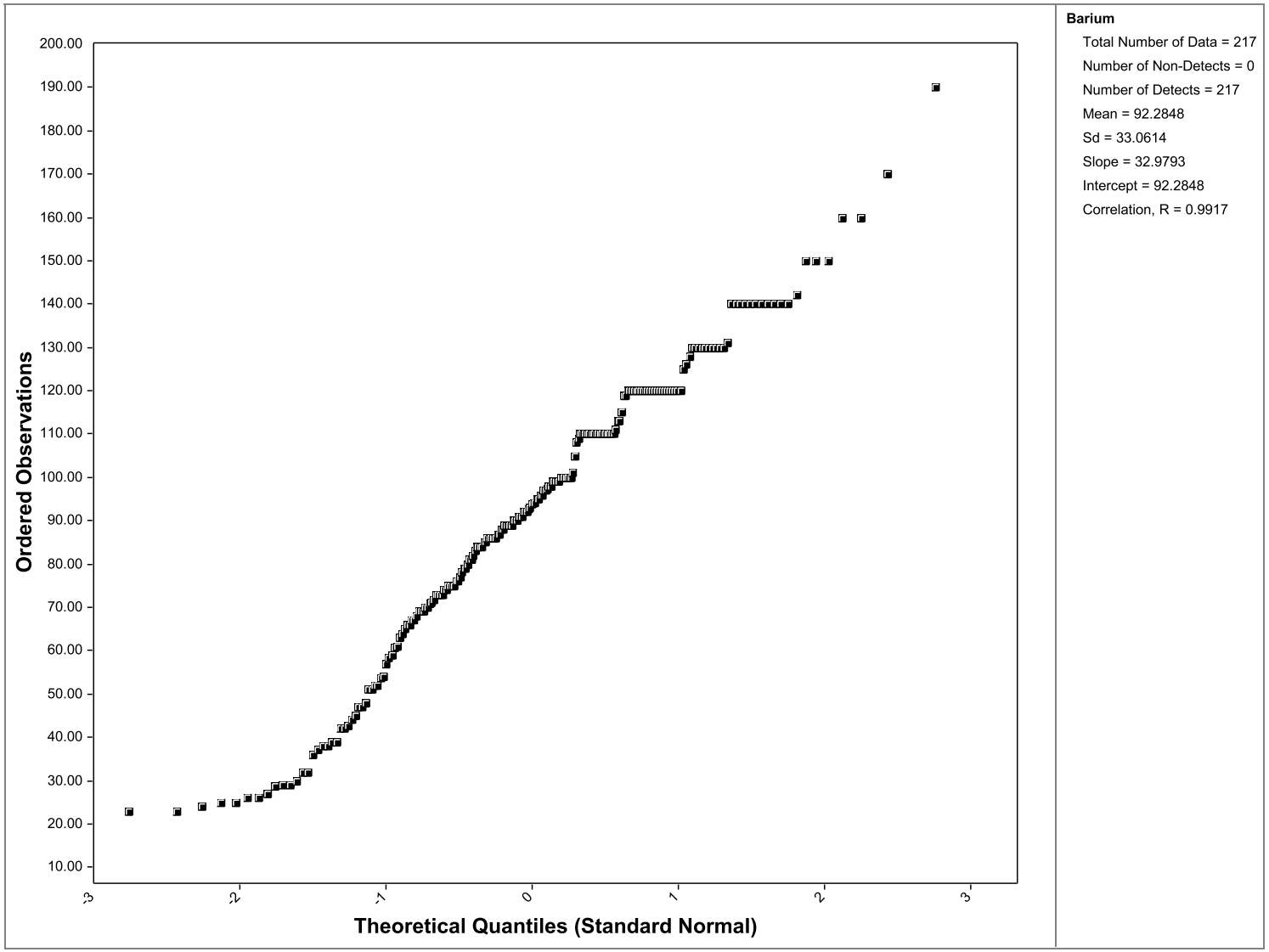
Lognormal Probability Plot for Arsenic, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_barium.ai

Attachment B-2

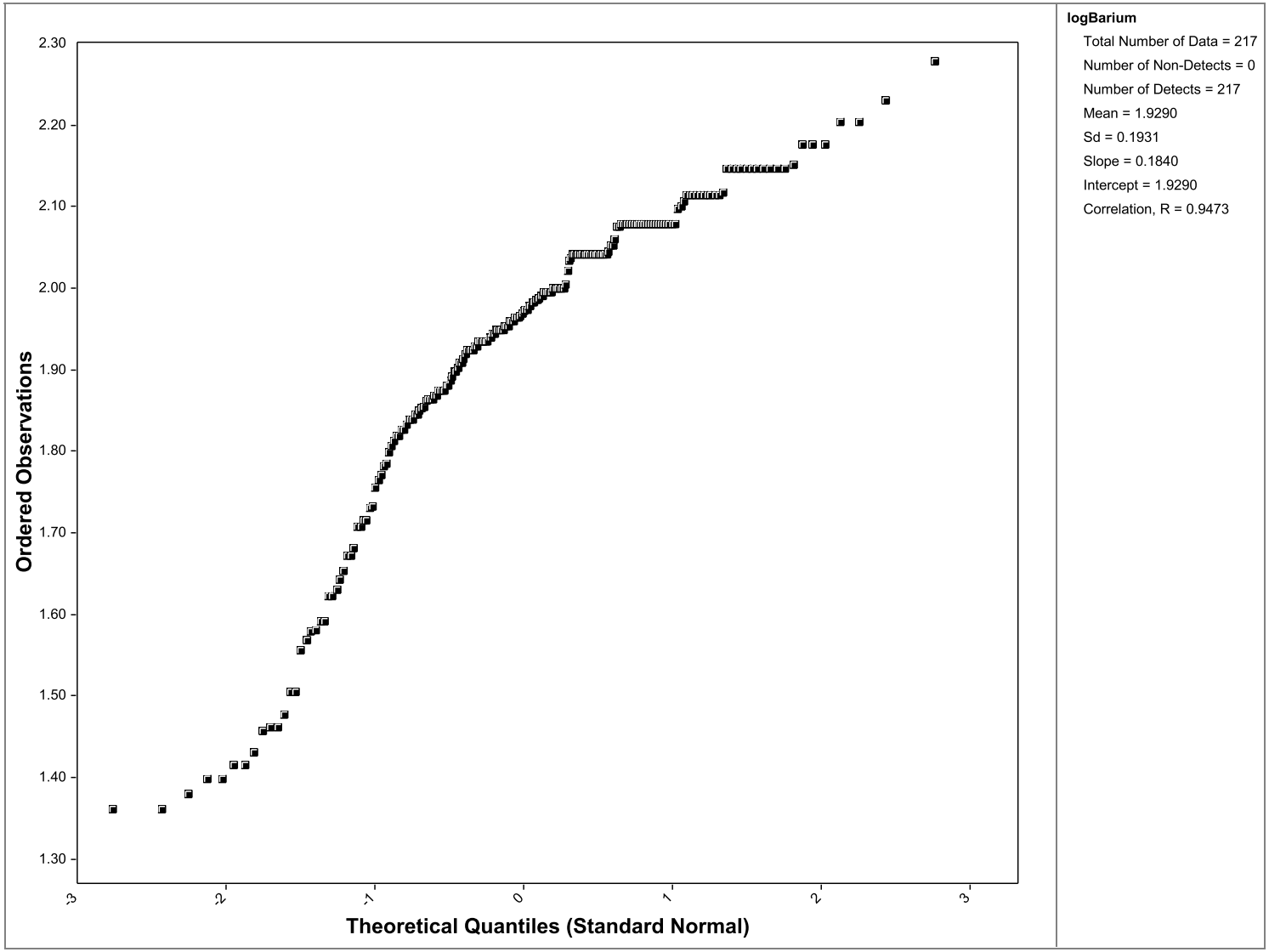
Normal Probability Plot for Barium



S:\10600\10627\10627.003\task-8_fig_barium.ai

Attachment B-2

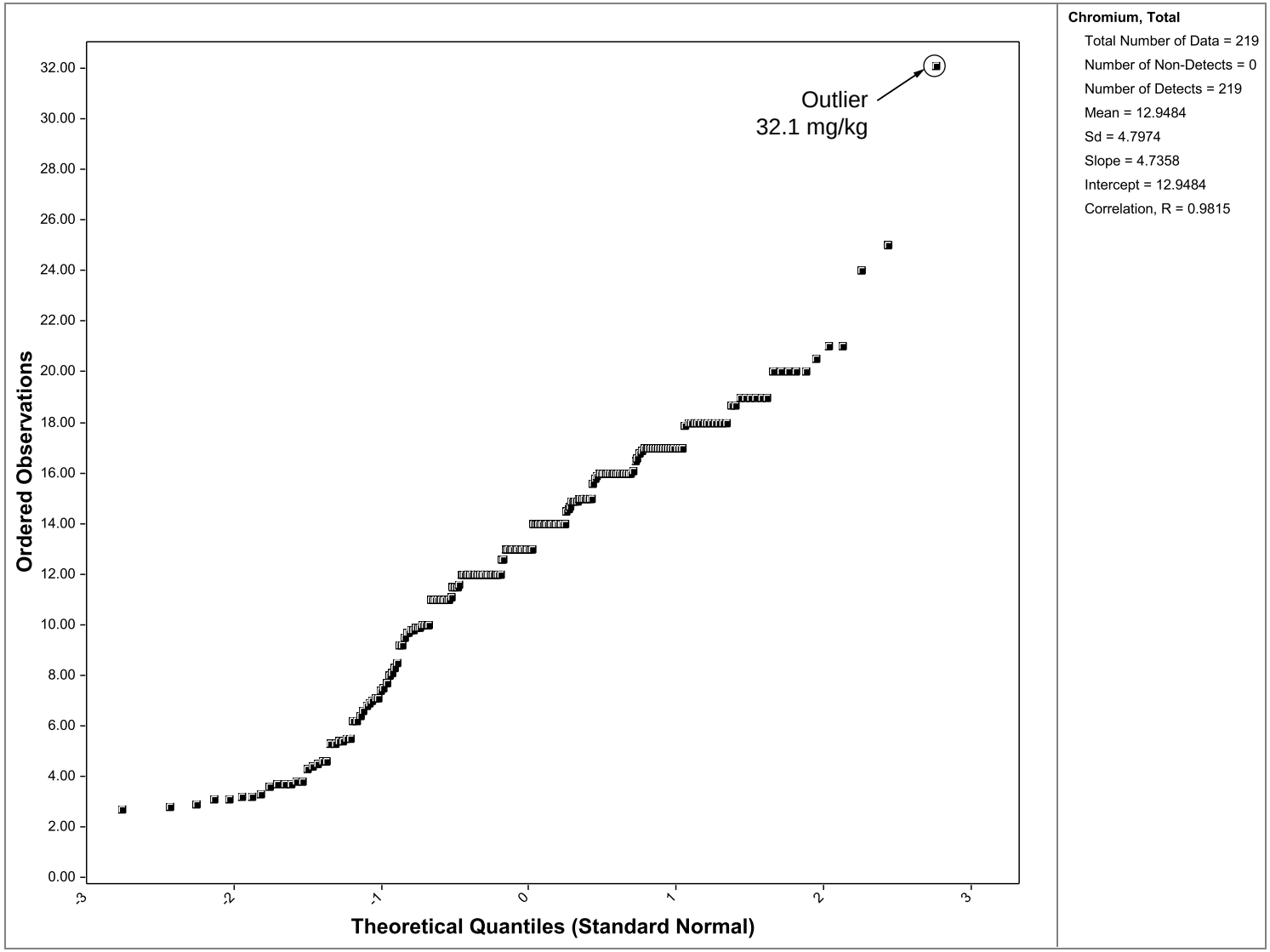
Lognormal Probability Plot for Barium



S:\10600\10627\10627.003\task-8_figs_chromium.ai

Attachment B-2

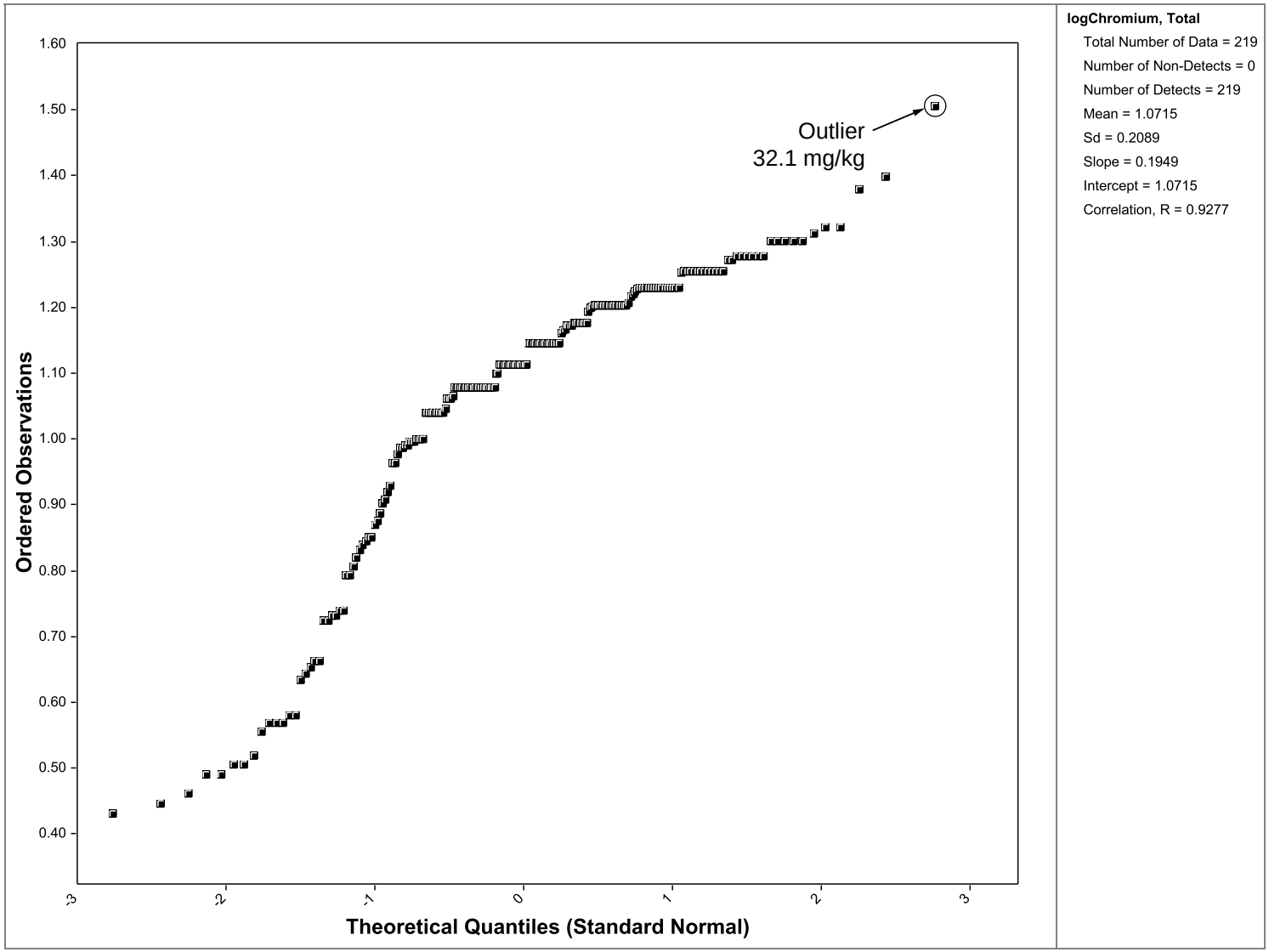
Normal Probability Plot for Total Chromium



S:\10600\10627\10627.003\task-8_figs_chromium.ai

Attachment B-2

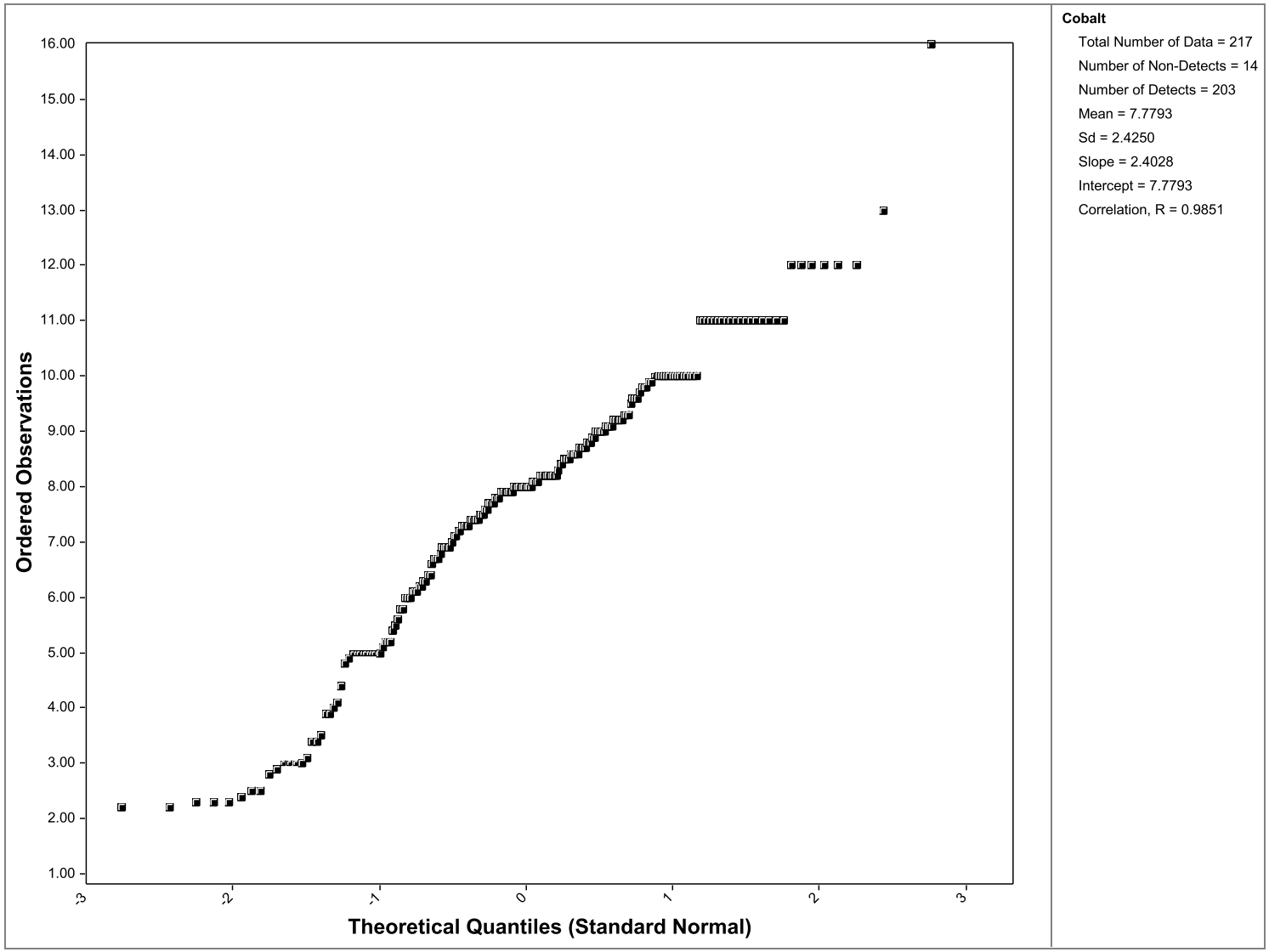
Lognormal Probability Plot for Total Chromium



S:\10600\10627\10627.003\task-8_figs_cobalt.ai

Attachment B-2

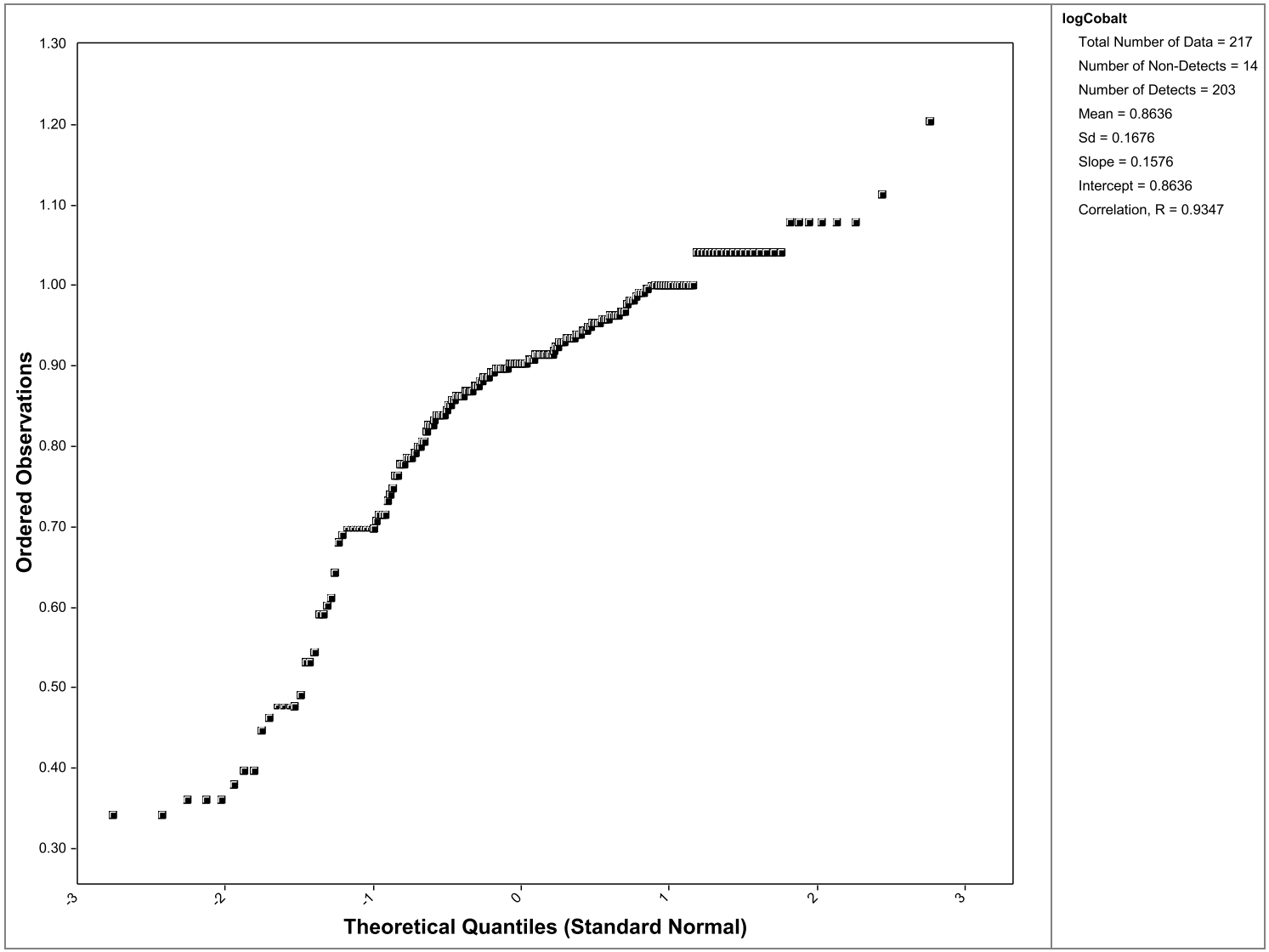
Normal Probability Plot for Cobalt



S:\10600\10627\10627.003\task-8_figs_cobalt.ai

Attachment B-2

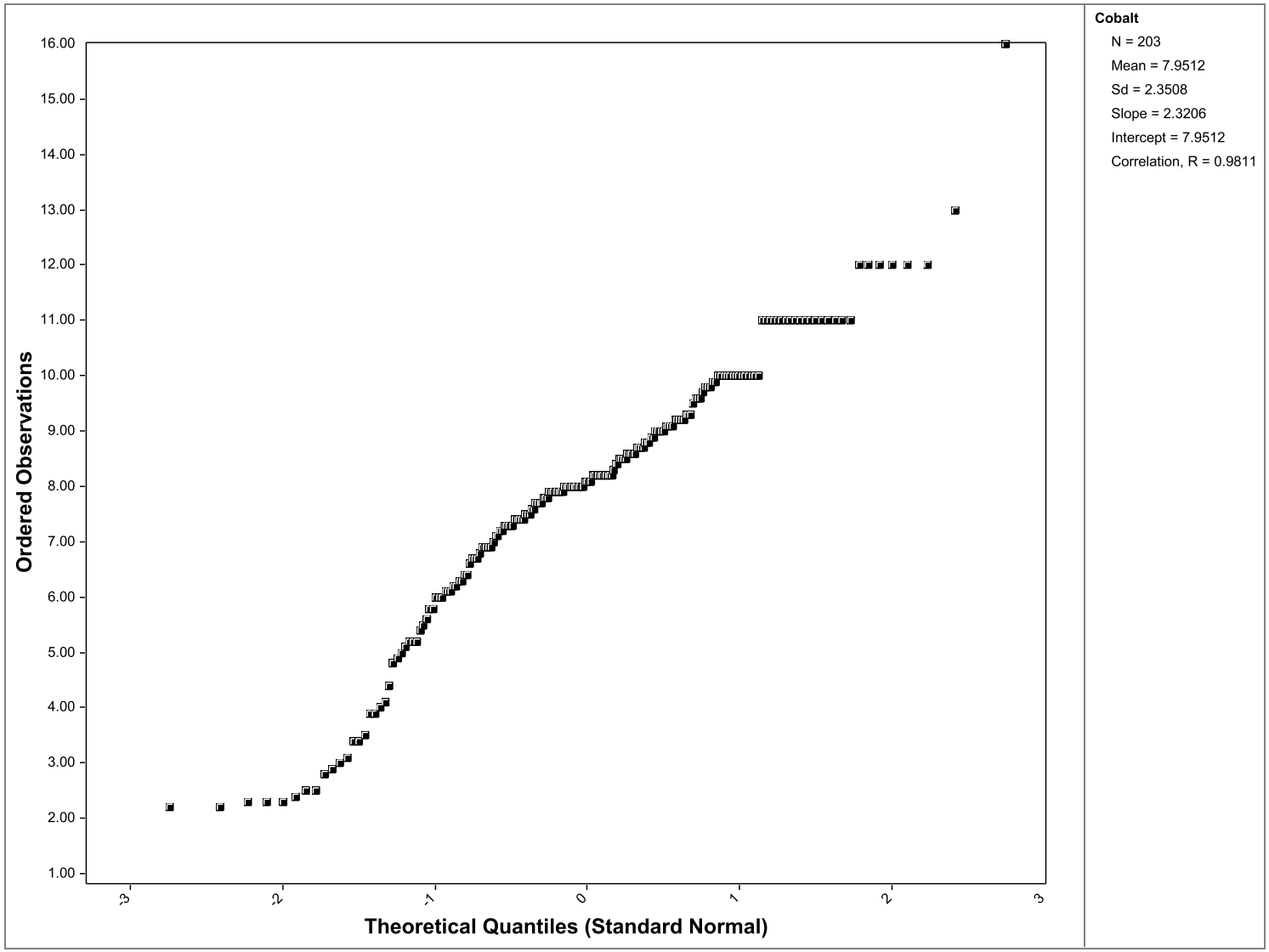
Lognormal Probability Plot for Cobalt



S:\10600\10627\10627.003\task-8_figs_cobalt.ai

Attachment B-2

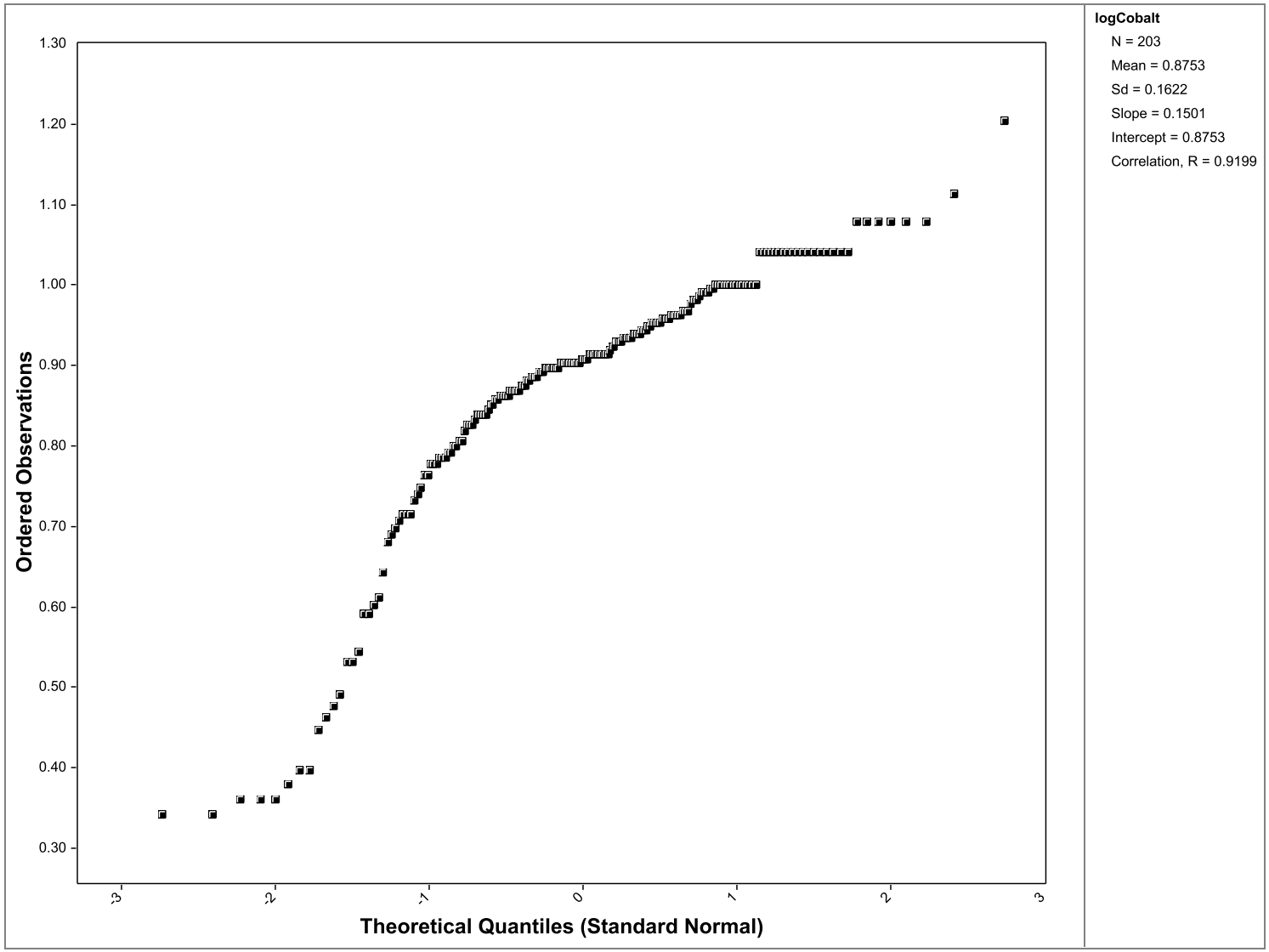
Normal Probability Plot for Cobalt, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_figs_cobalt.ai

Attachment B-2

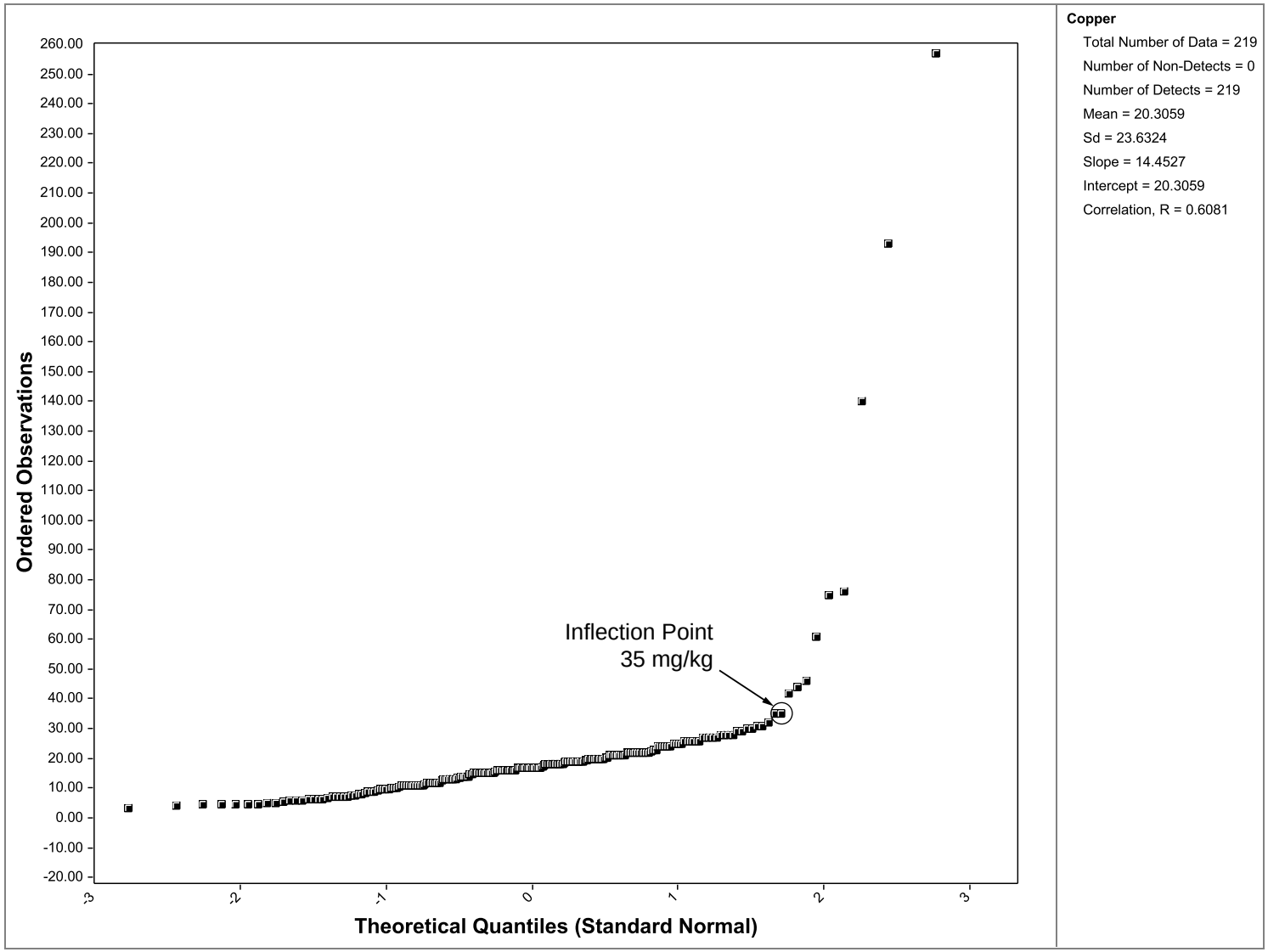
Lognormal Probability Plot for Cobalt, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_copper.ai

Attachment B-2

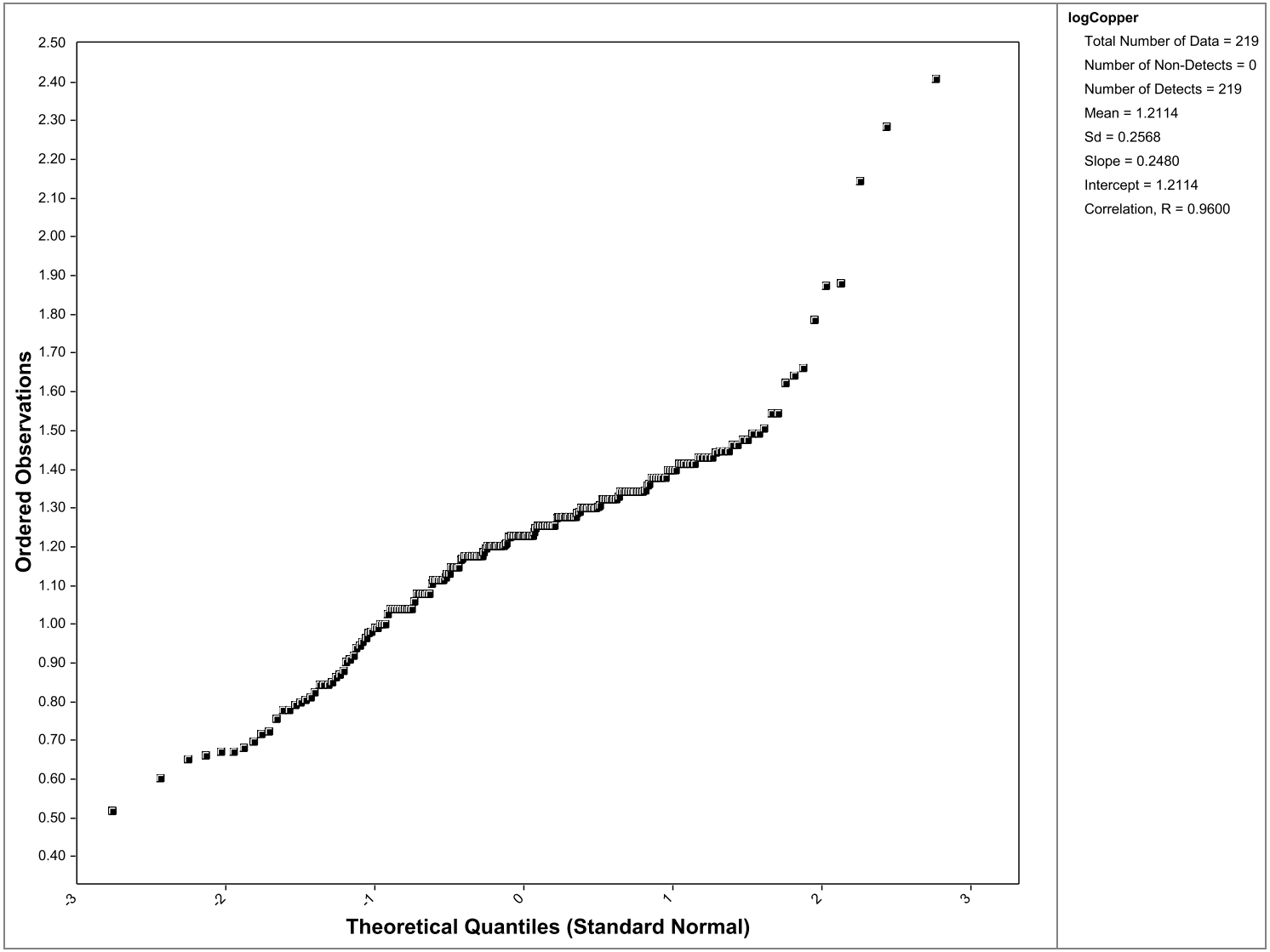
Normal Probability Plot for Copper



S:\10600\10627\10627.003\task-8_fig_copper.ai

Attachment B-2

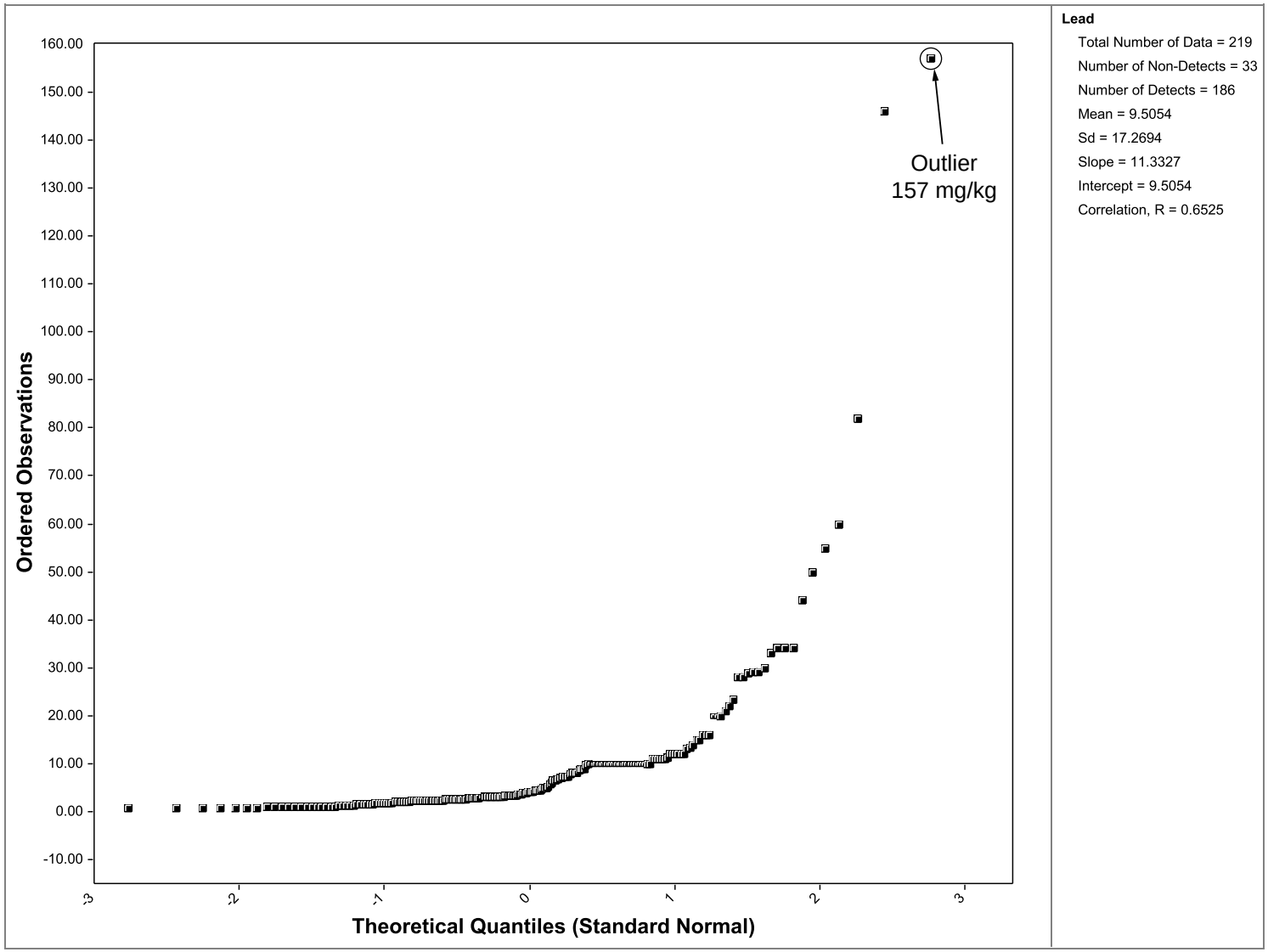
Lognormal Probability Plot for Copper



S:\10600\10627\10627.003\task-8_fig_lead.ai

Attachment B-2

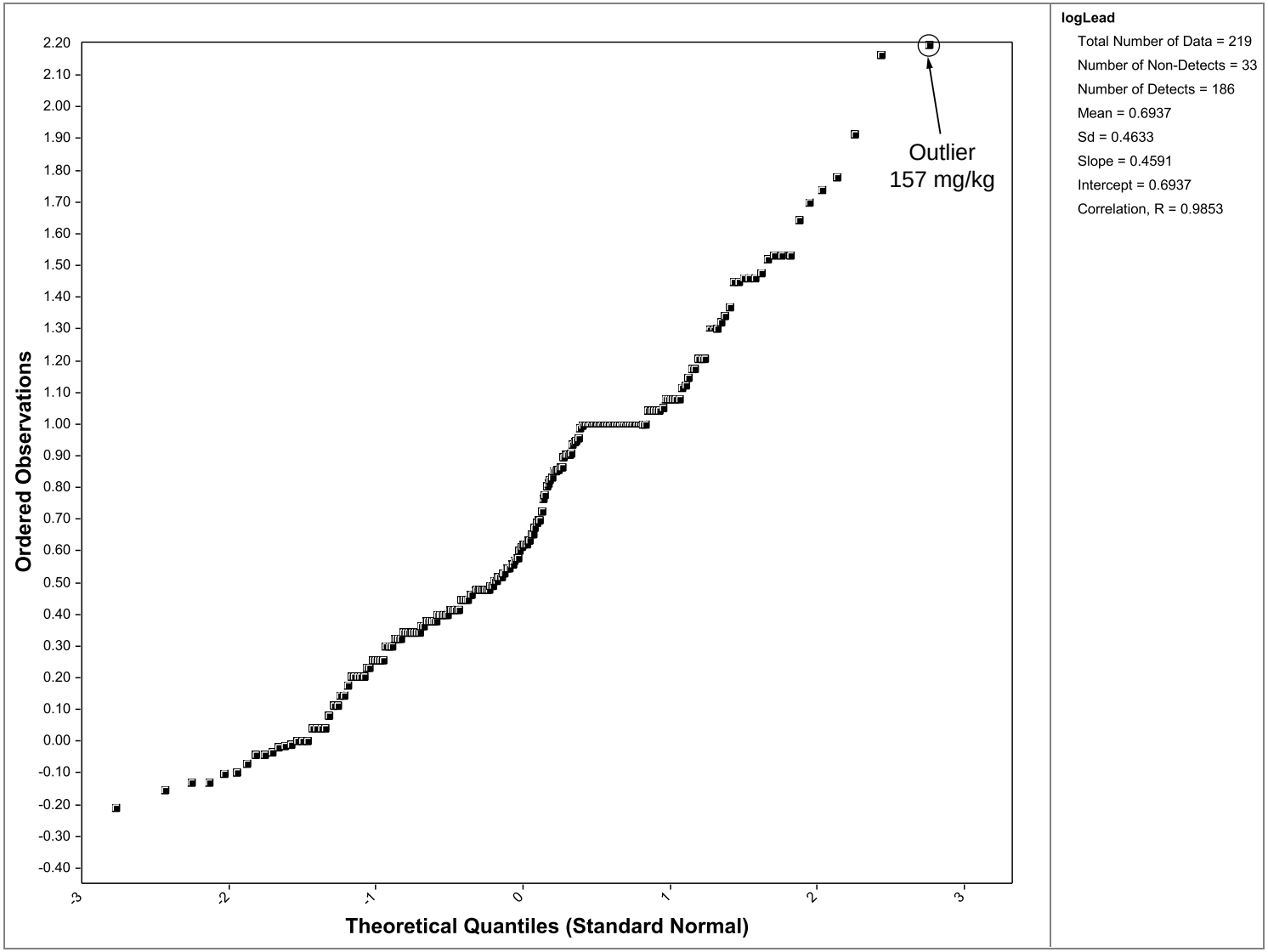
Normal Probability Plot for Lead



S:\10600\10627\10627.003\task-8_fig_lead.ai

Attachment B-2

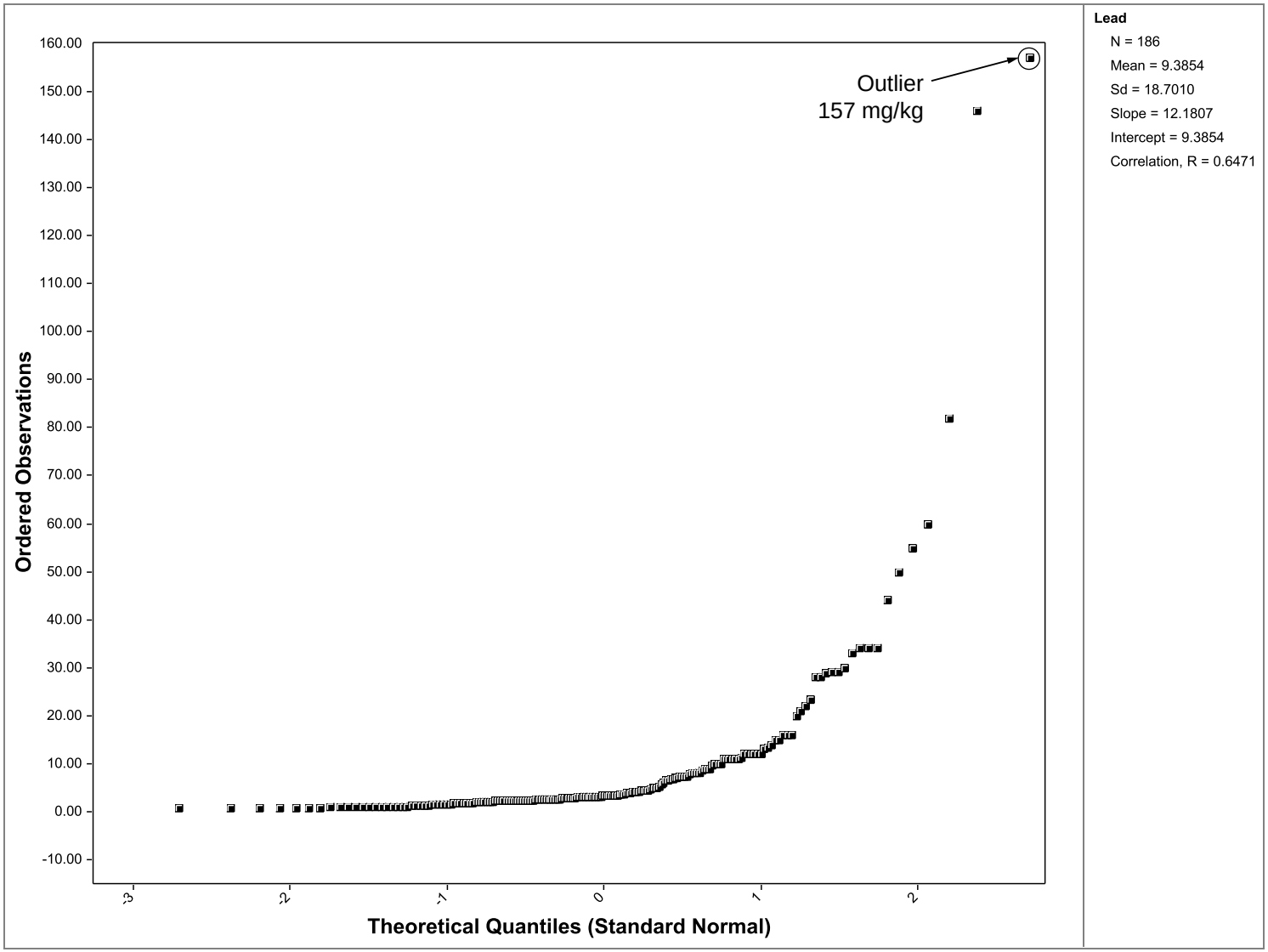
Lognormal Probability Plot for Lead



S:\10600\10627\10627.003\task-8_fig_lead.ai

Attachment B-2

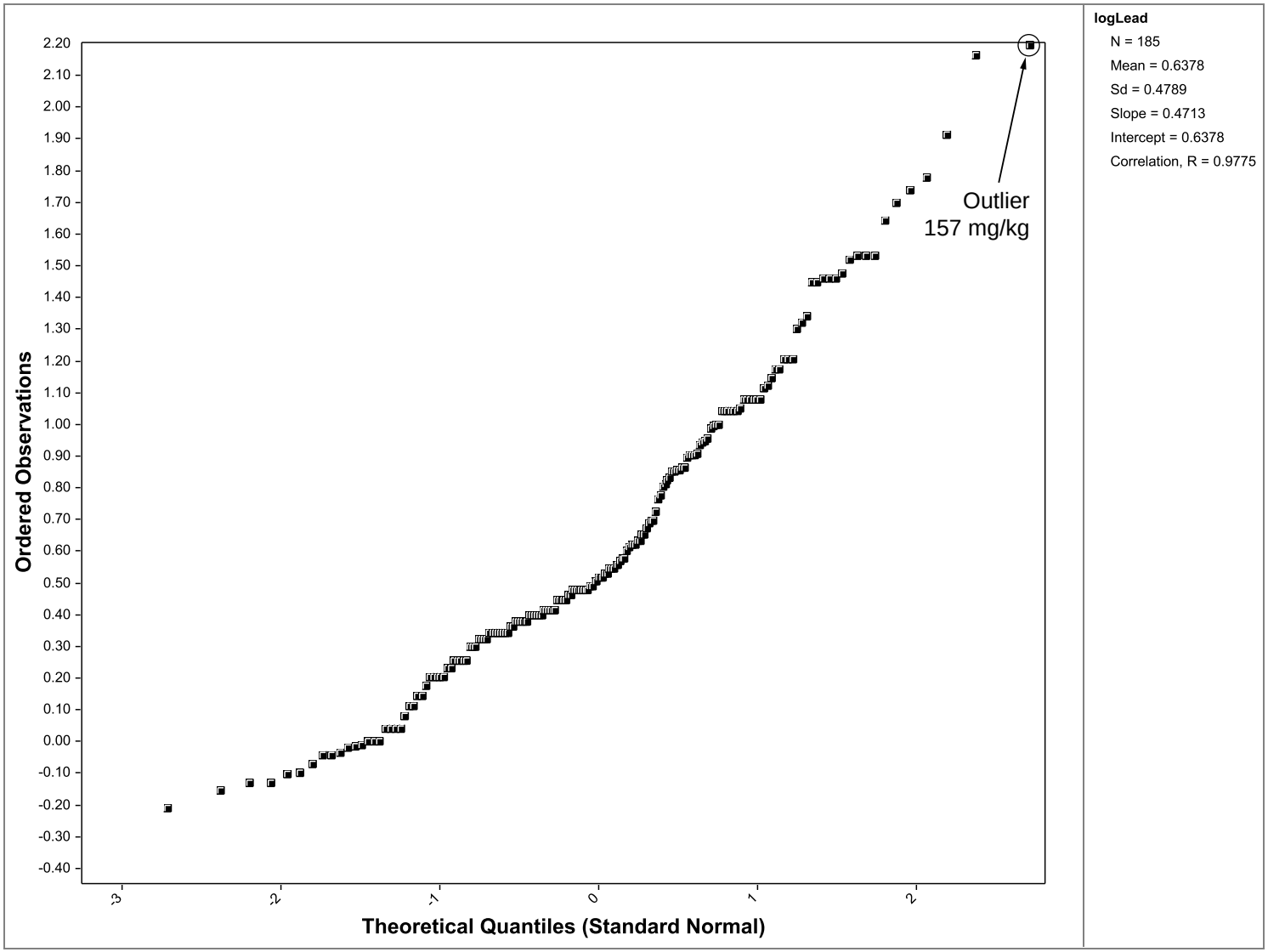
Normal Probability Plot for Lead, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_lead.ai

Attachment B-2

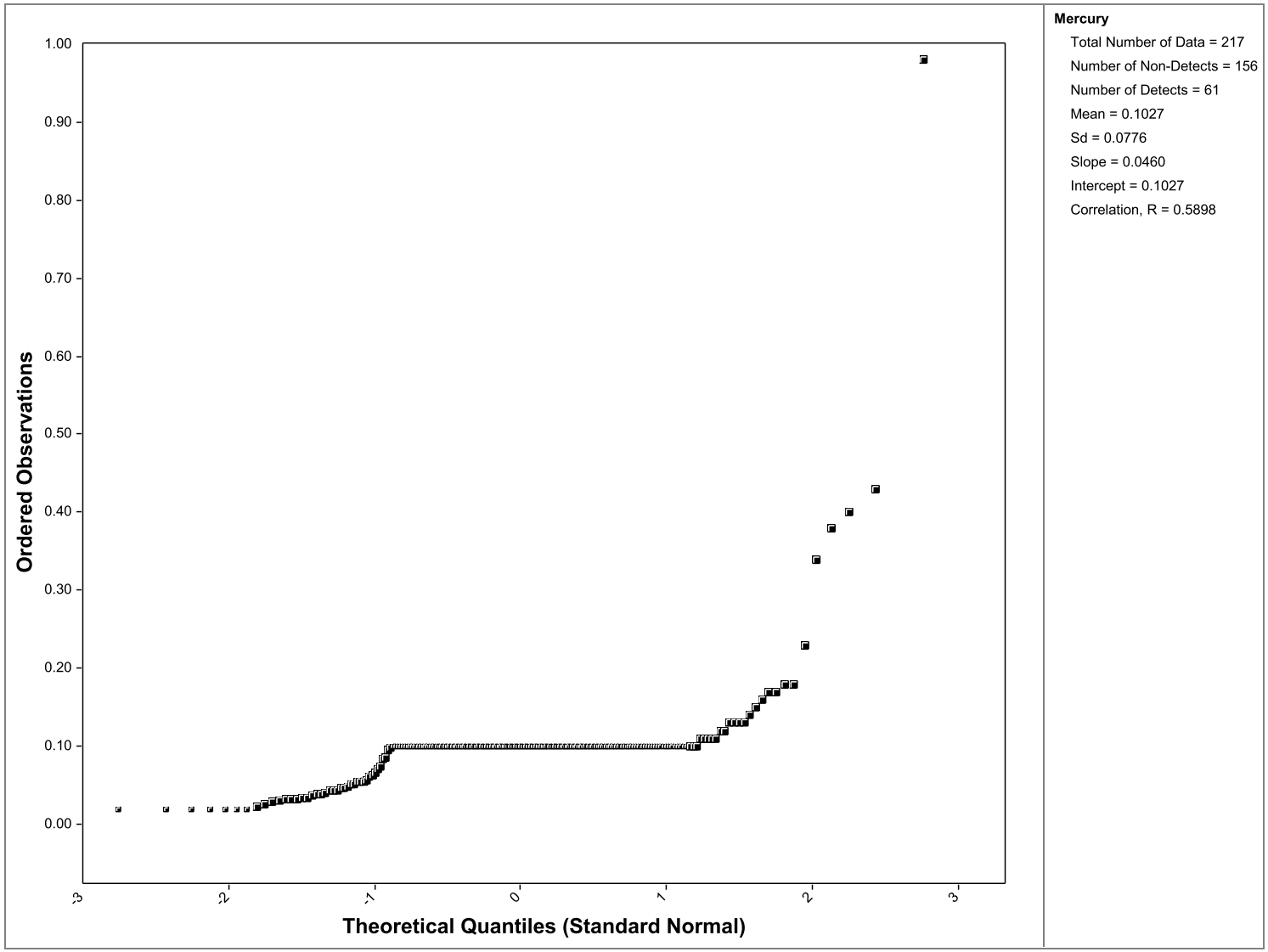
Lognormal Probability Plot for Lead, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_mercury.ai

Attachment B-2

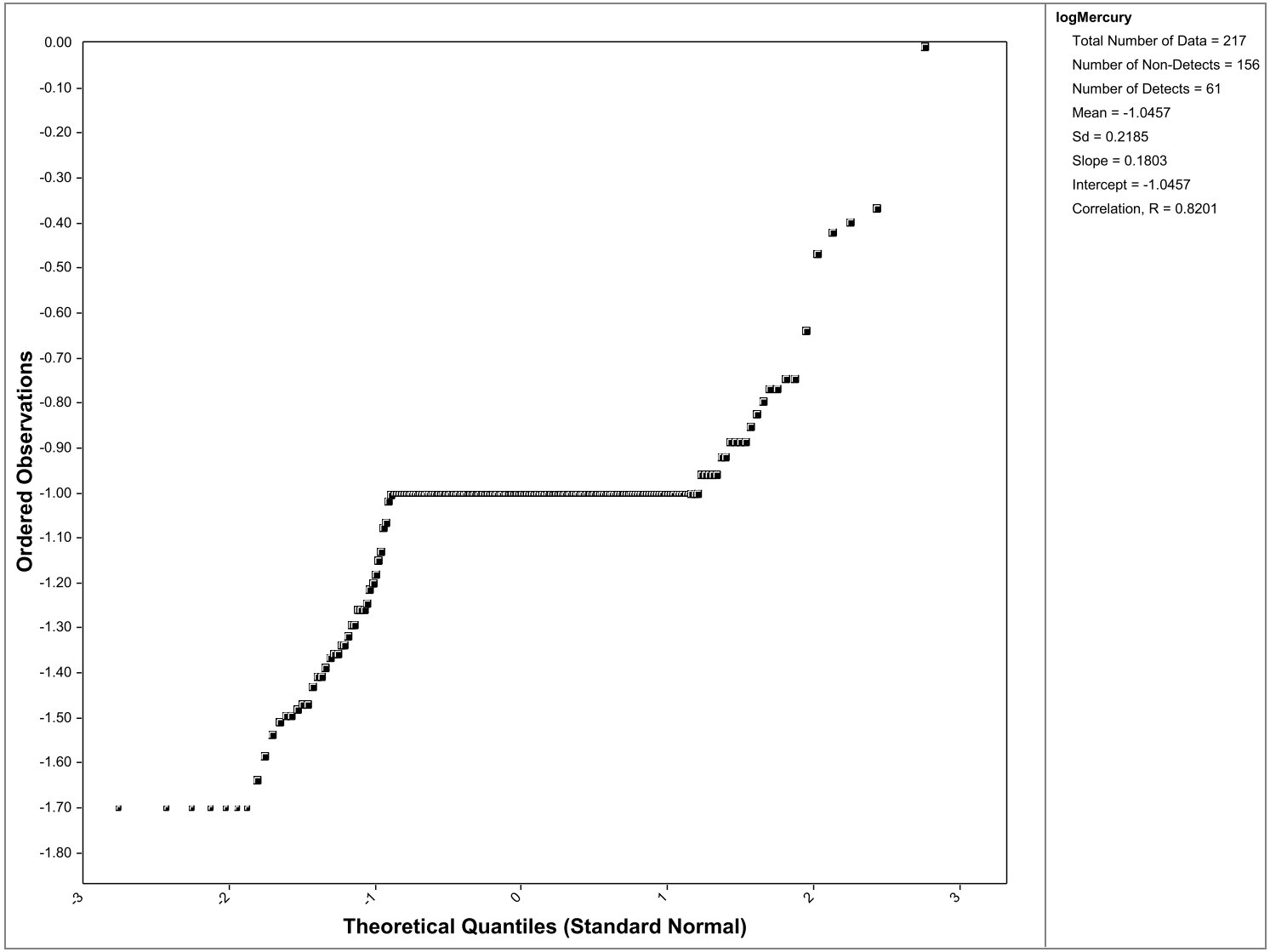
Normal Probability Plot for Mercury



S:\10600\10627\10627.003\task-8_fig_mercury.ai

Attachment B-2

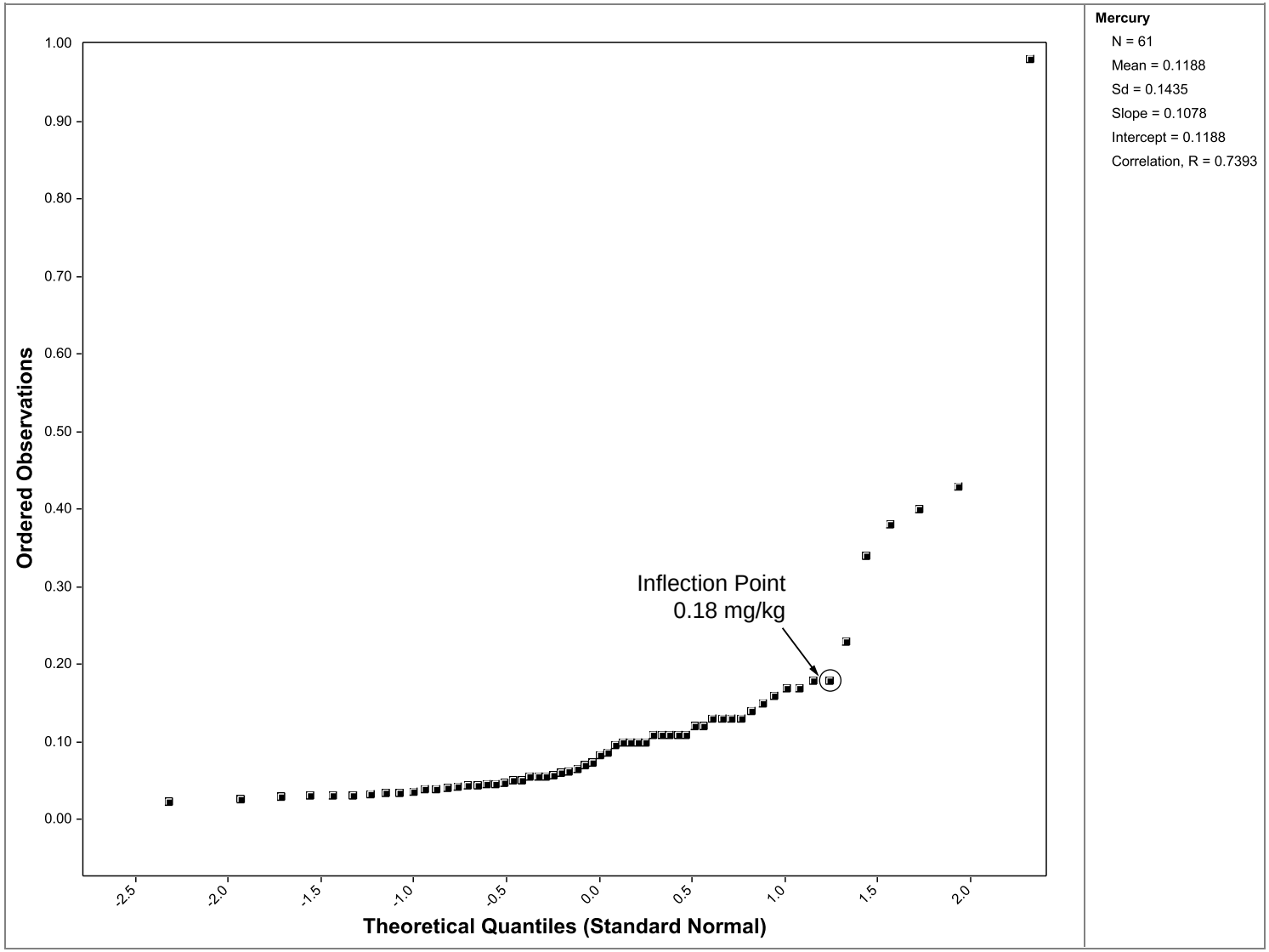
Lognormal Probability Plot for Mercury



S:\10600\10627\10627.003\task-8_fig_mercury.ai

Attachment B-2

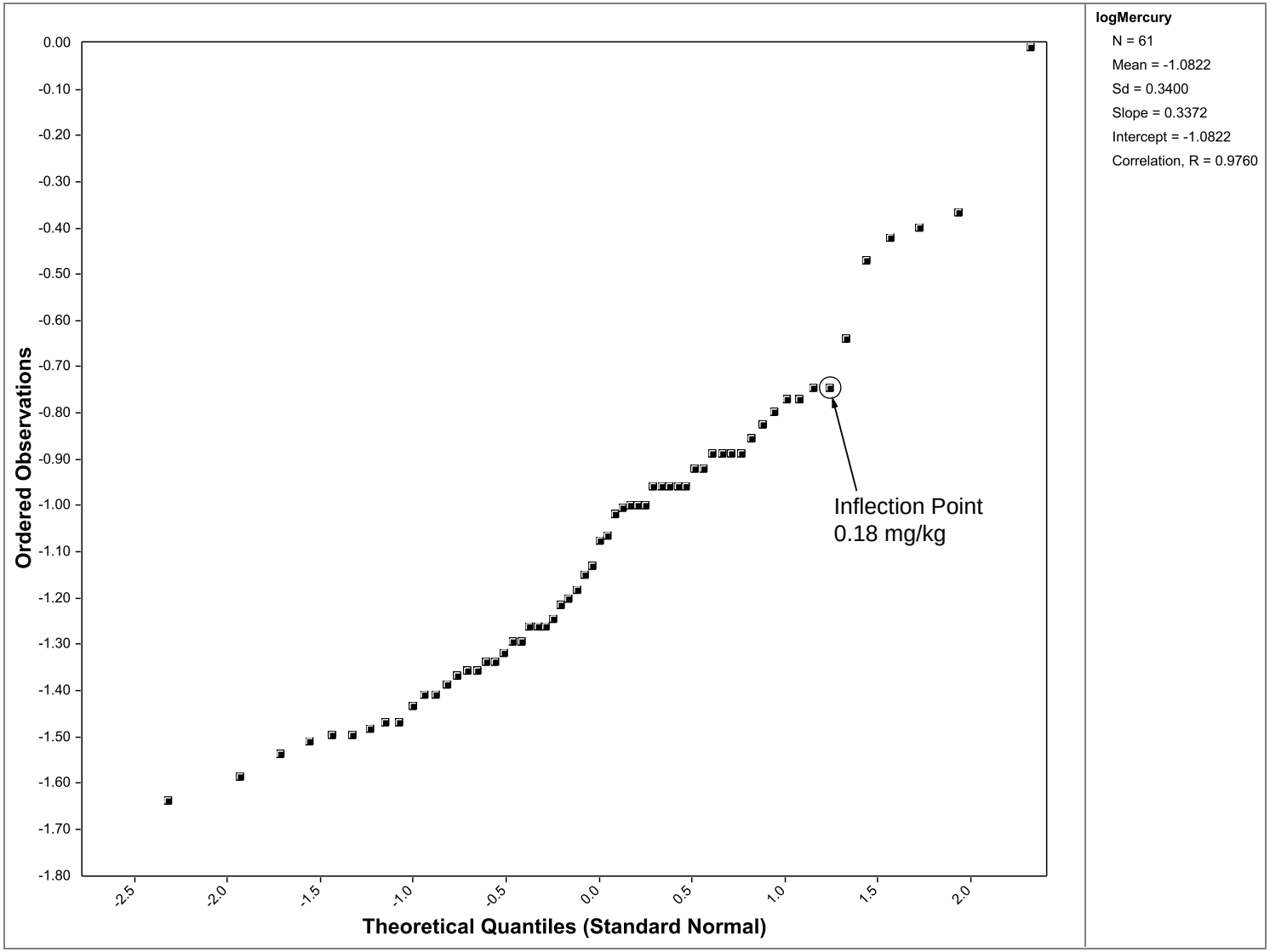
Normal Probability Plot for Mercury, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_mercury.ai

Attachment B-2

Lognormal Probability Plot for Mercury, Non-detect Concentrations Removed



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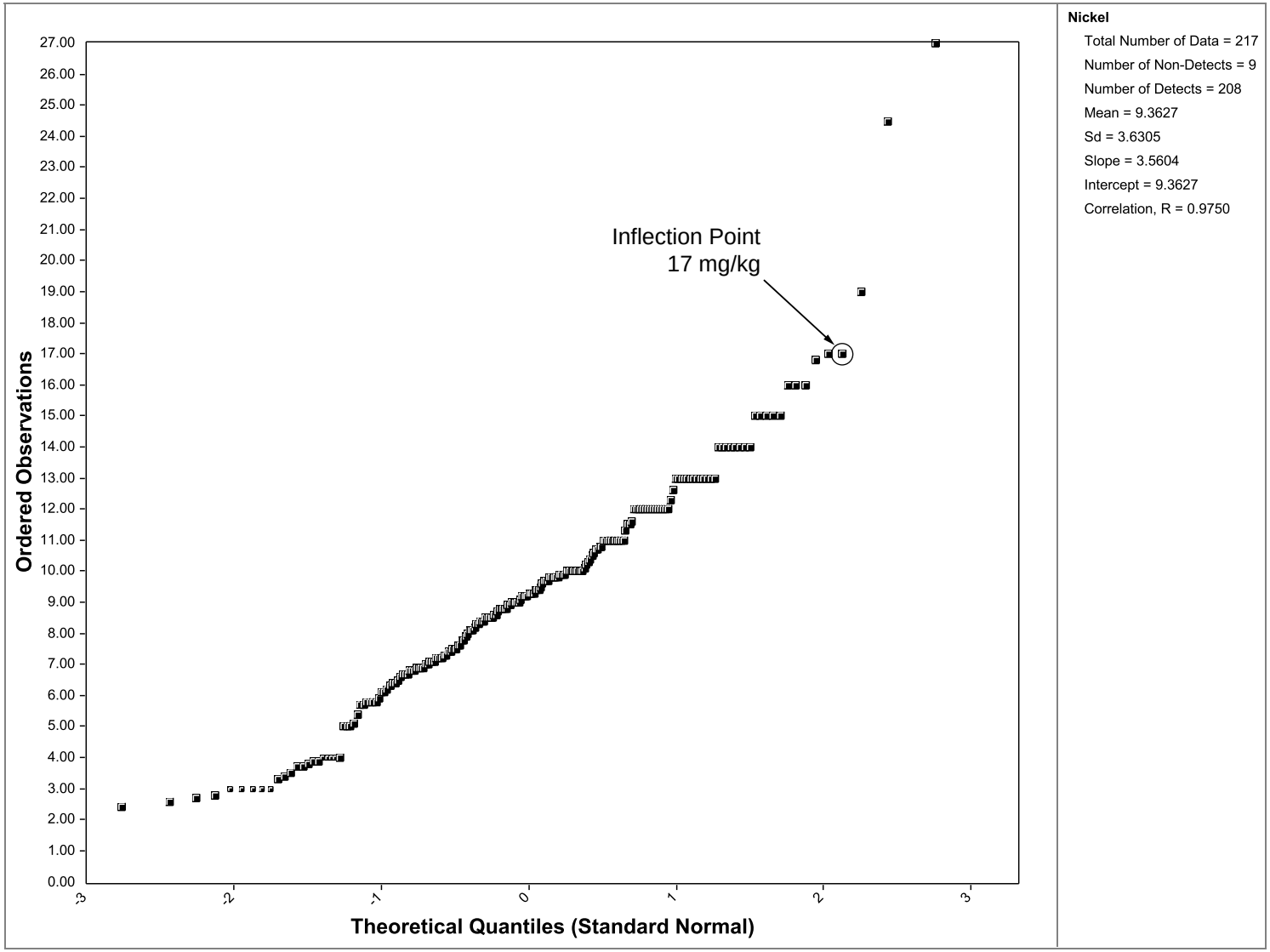
Attachment B-2

Normal Probability Plot for Nickel



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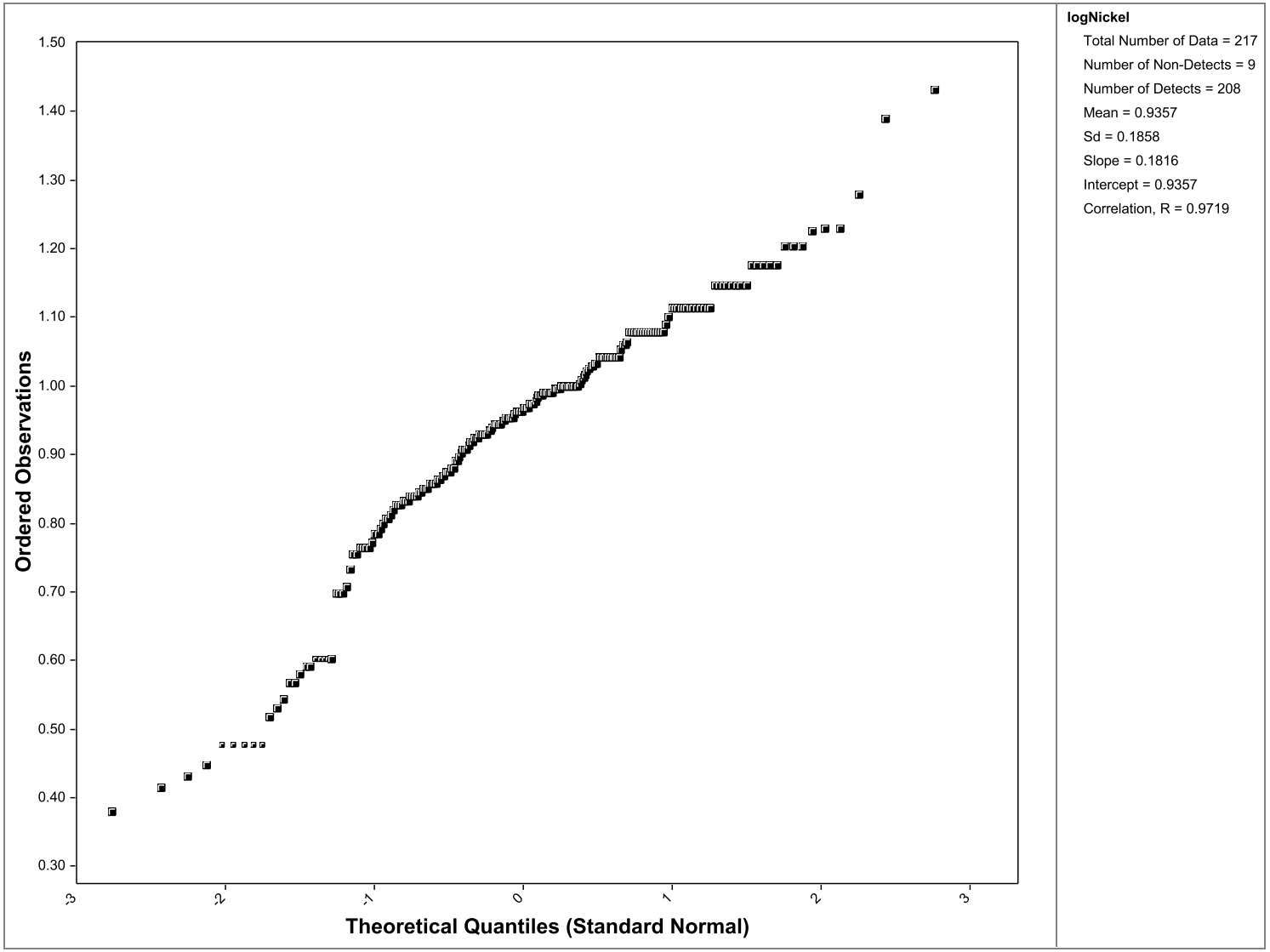
Attachment B-2

Lognormal Probability Plot for Nickel



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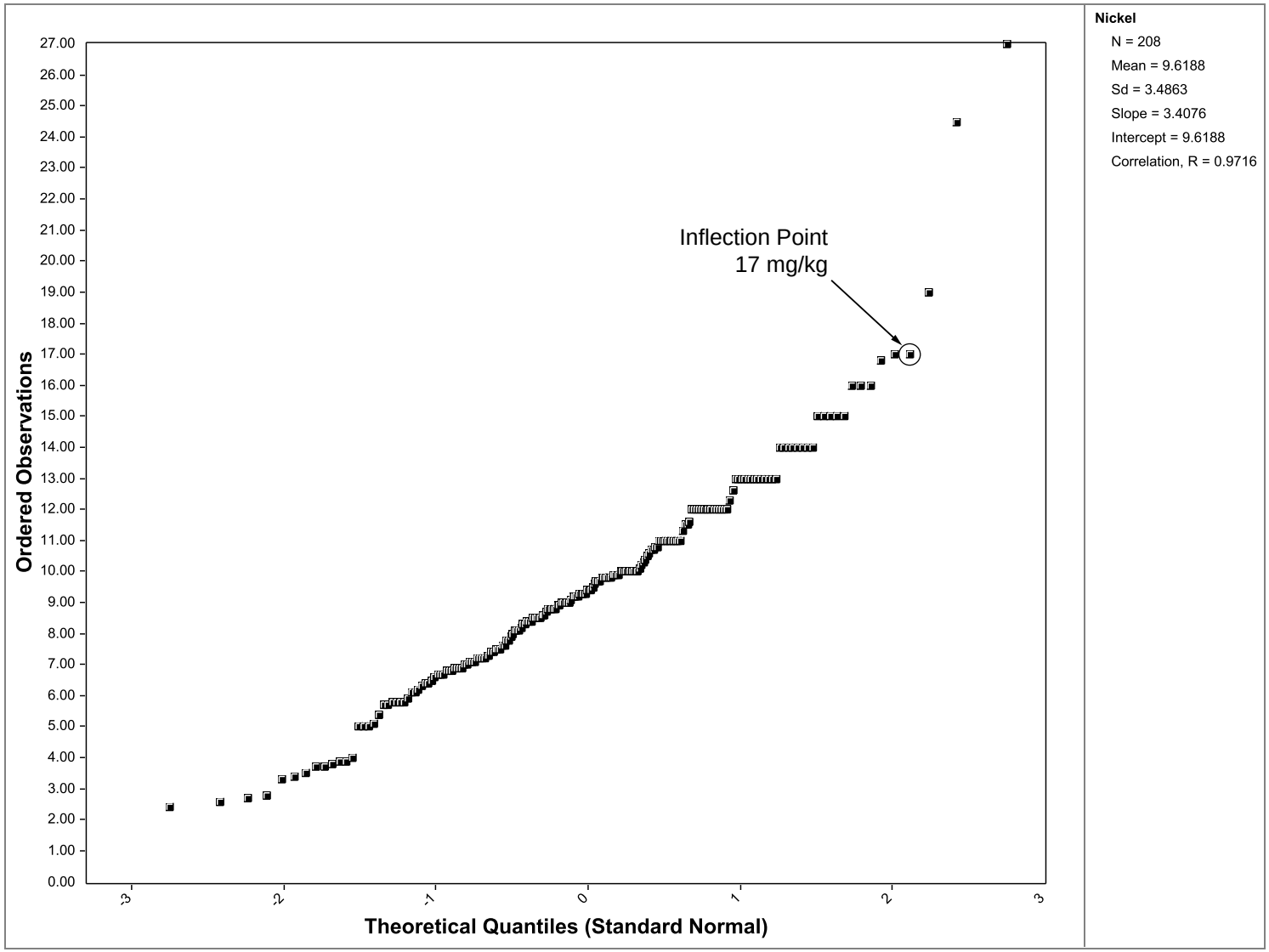
Attachment B-2

Normal Probability Plot for Nickel, Non-detect Concentrations Removed



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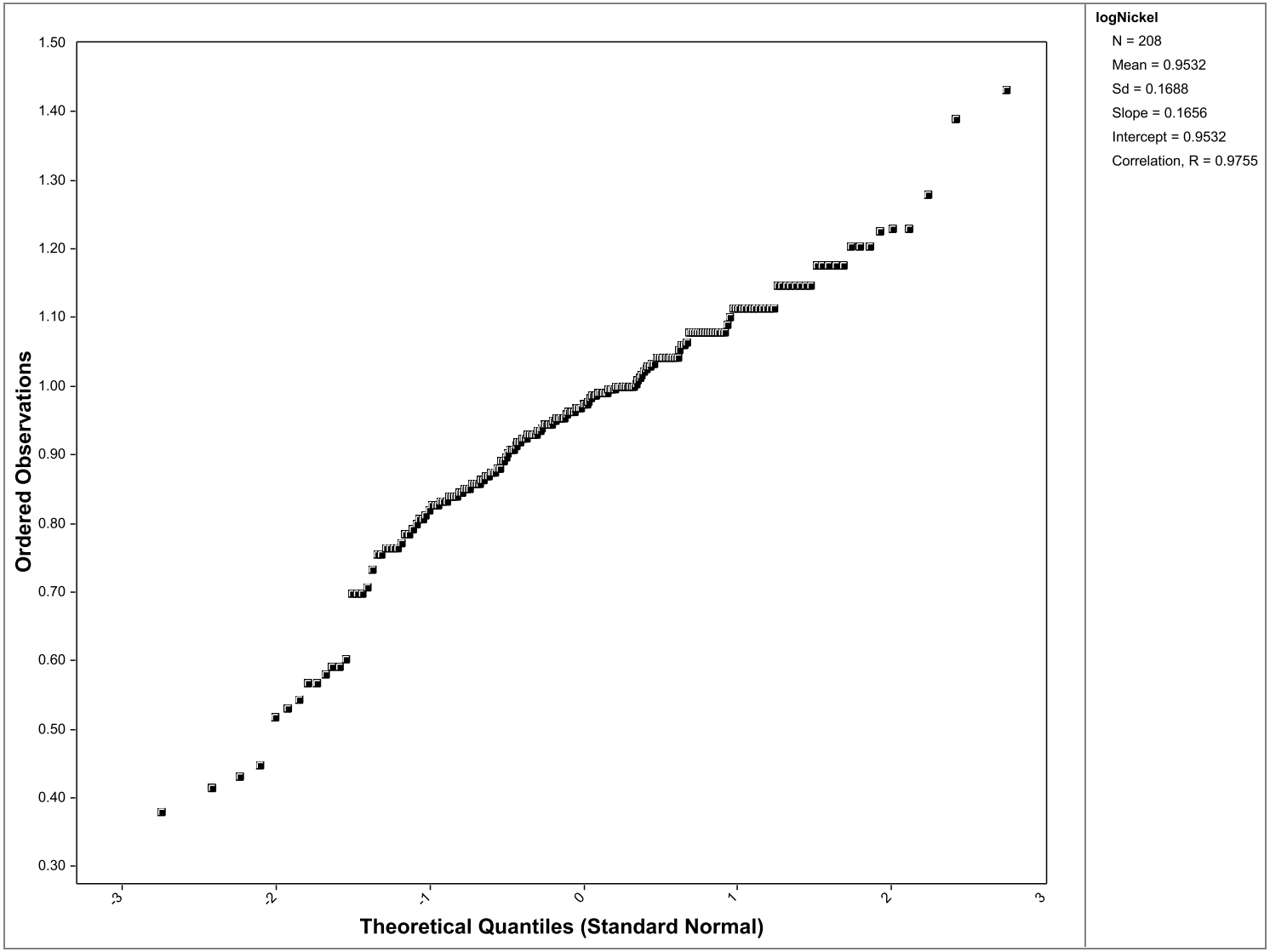
Attachment B-2

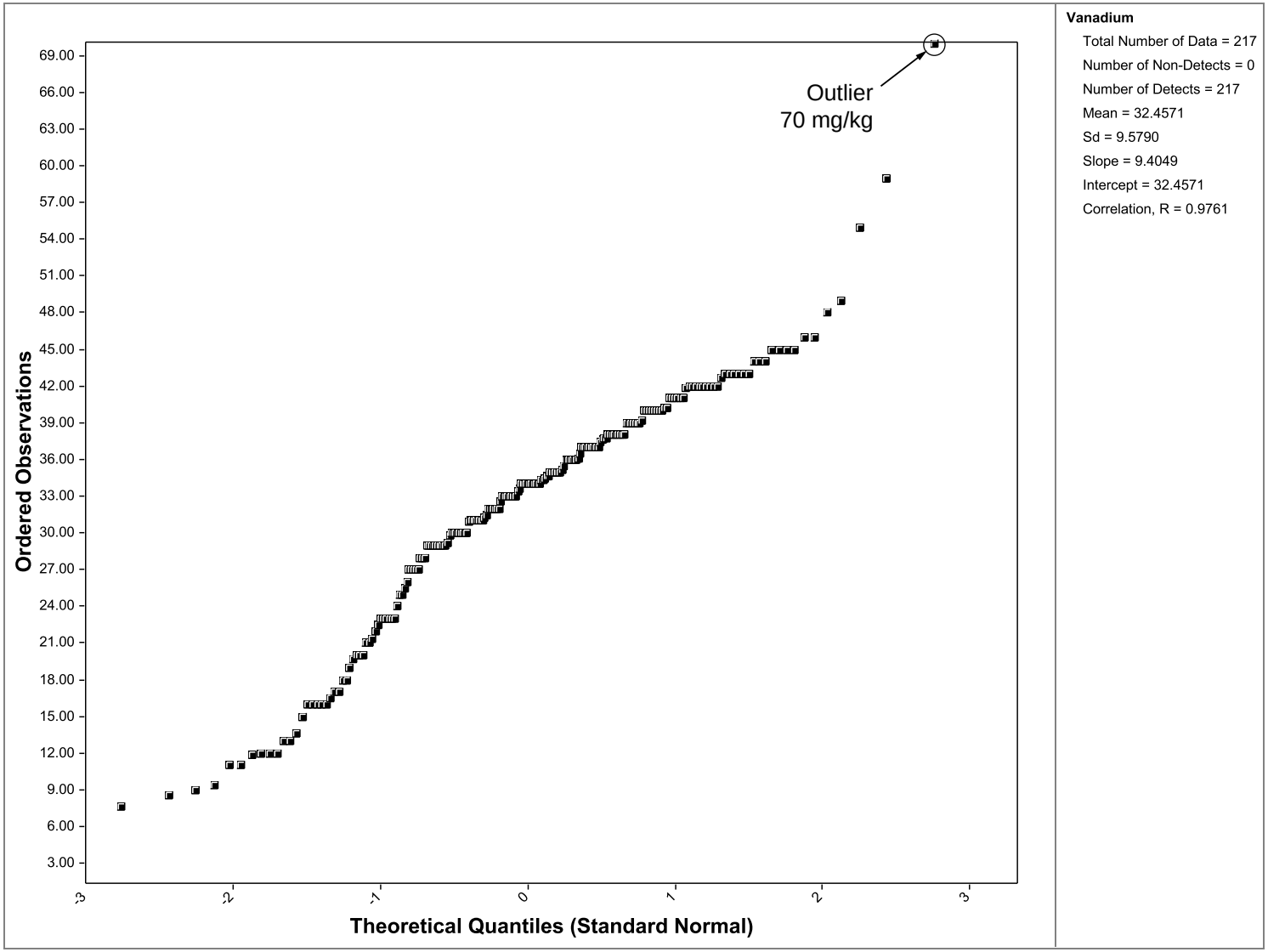
Lognormal Probability Plot for Nickel, Non-detect Concentrations Removed



S:\10600\10627\10627.003\task-8_fig_vanadium.ai

Attachment B-2

Normal Probability Plot for Vanadium



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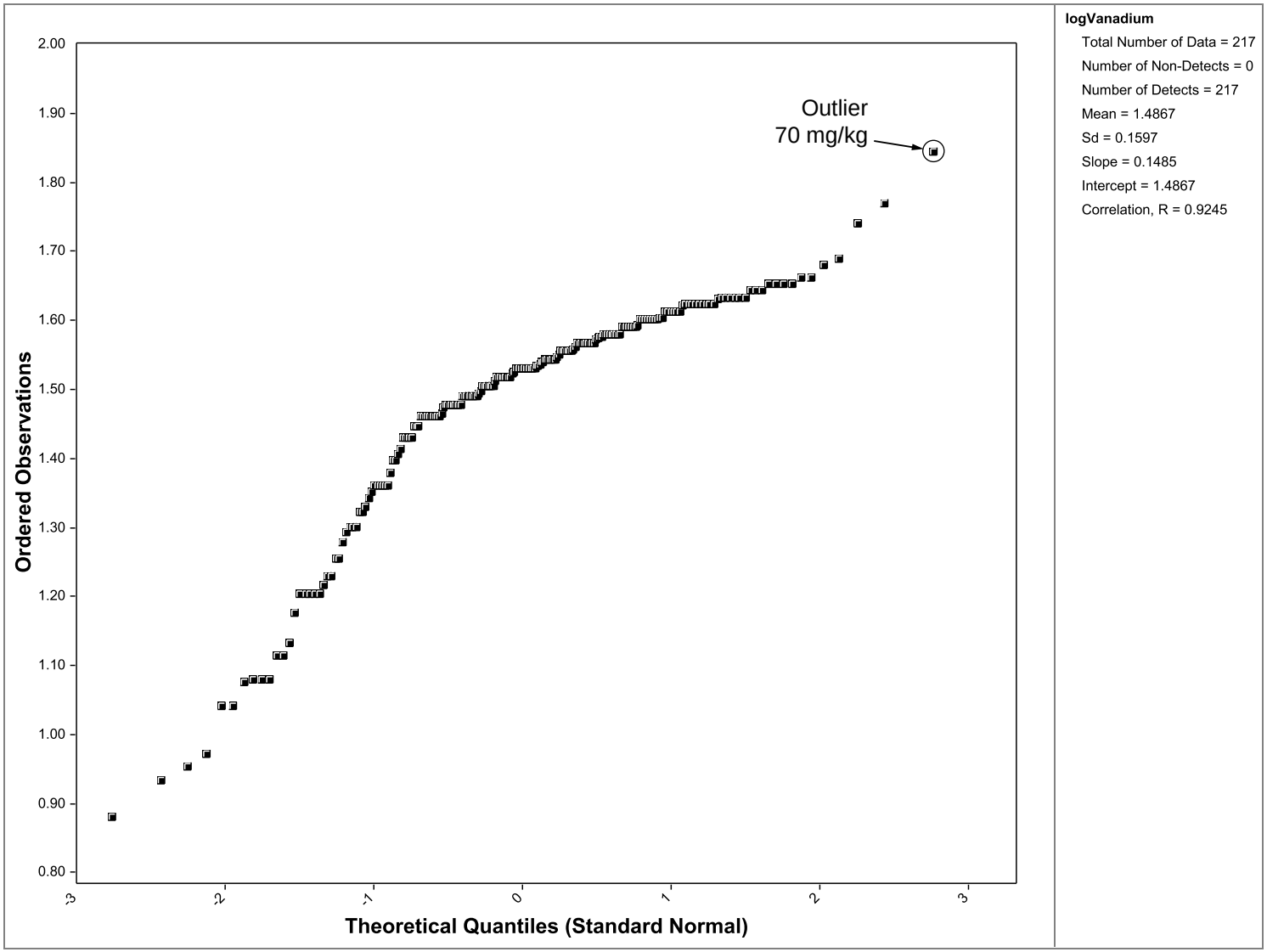
Attachment B-2

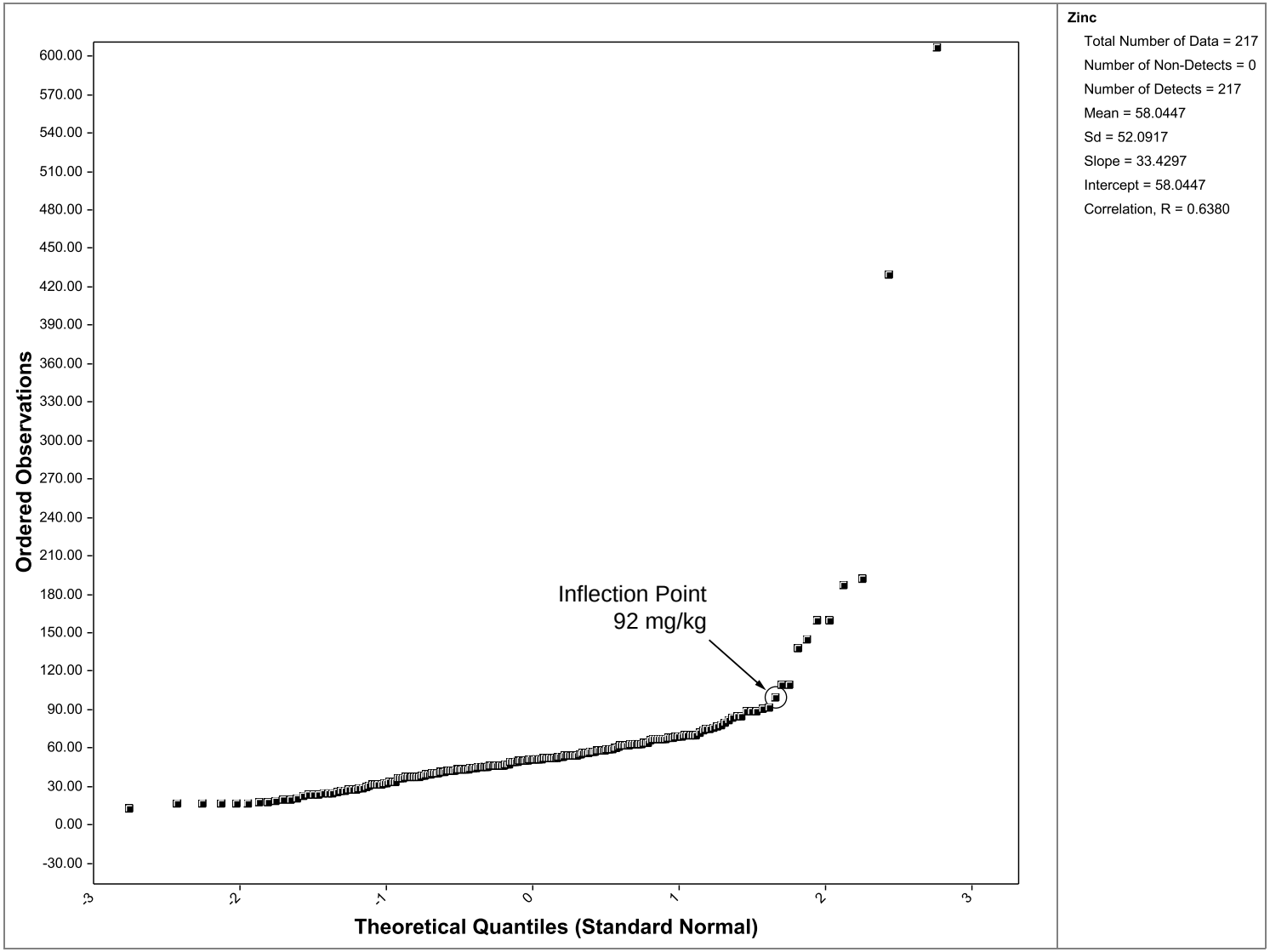
Lognormal Probability Plot for Vanadium



S:\10600\10627\10627.003\task-8_fig_zinc.ai

Attachment B-2

Normal Probability Plot for Zinc



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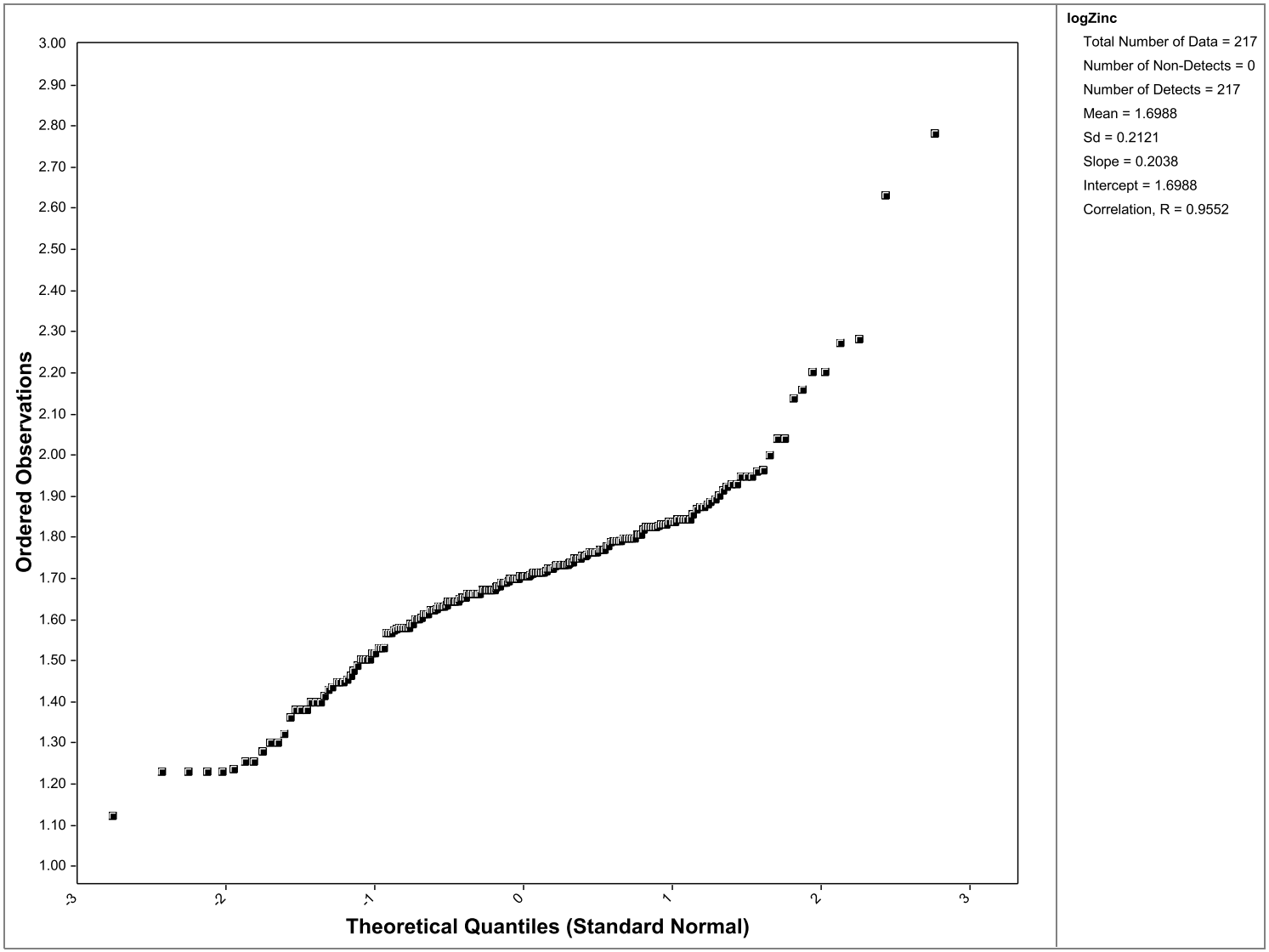
Attachment B-2

Lognormal Probability Plot for Zinc



ATTACHMENT B-3
ProUCL 4.00.04 OUTPUT -- ROSNER'S OUTLIER TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Rosner's Outlier Test for Barium

Mean	92.28
Standard Deviation	33.06
Number of data	217
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	92.28	32.99	190	105	2.962	3.629	4

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

ATTACHMENT B-3
ProUCL 4.00.04 OUTPUT -- ROSNER'S OUTLIER TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Rosner's Outlier Test for Chromium, Total

Mean	12.95
Standard Deviation	4.797
Number of data	219
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	12.95	4.786	32.1	27	4.001	3.632	4.003

For 5% Significance Level, there is 1 Potential Outlier
Therefore, Observation 32.1 is a Potential Statistical Outlier

For 1% Significance Level, there is no Potential Outlier

ATTACHMENT B-3
ProUCL 4.00.04 OUTPUT -- ROSNER'S OUTLIER TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Rosner's Outlier Test for Cobalt

Mean	7.951
Standard Deviation	2.351
Number of data	203
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	7.951	2.345	16	129	3.432	3.612	3.984

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

ATTACHMENT B-3
ProUCL 4.00.04 OUTPUT -- ROSNER'S OUTLIER TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Rosner's Outlier Test for Lead

Mean	9.385
Standard Deviation	18.7
Number of data	186
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	9.385	18.65	157	41	7.915	3.585	3.955

For 5% Significance Level, there is 1 Potential Outlier
Therefore, Observation 157 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier
Therefore, Observation 157 is a Potential Statistical Outlier

ATTACHMENT B-3
ProUCL 4.00.04 OUTPUT -- ROSNER'S OUTLIER TESTS
Former Pechiney Cast Plate, Inc. Facility
Vernon, California

Rosner's Outlier Test for Vanadium

Mean	32.46
Standard Deviation	9.579
Number of data	217
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	32.46	9.557	70	39	3.928	3.629	4

For 5% Significance Level, there is 1 Potential Outlier
Therefore, Observation 70 is a Potential Statistical Outlier

For 1% Significance Level, there is no Potential Outlier